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No. 658.]

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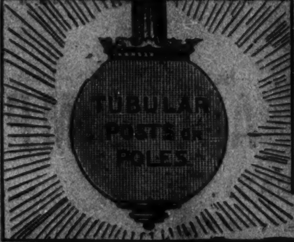

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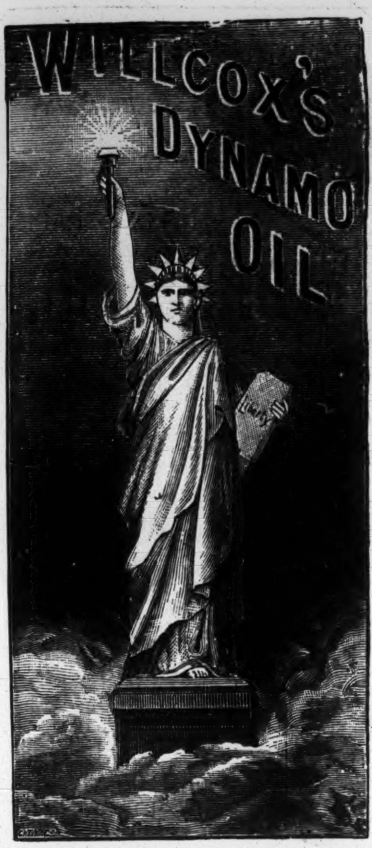

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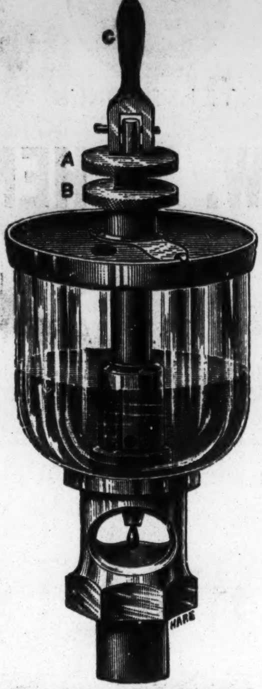

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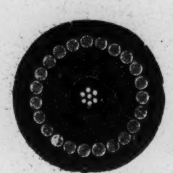

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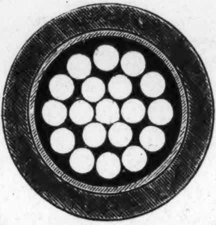

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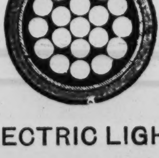

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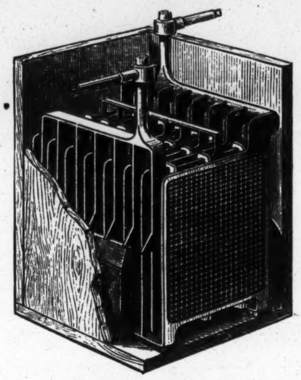

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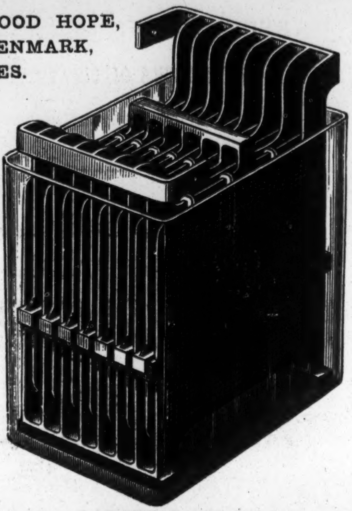

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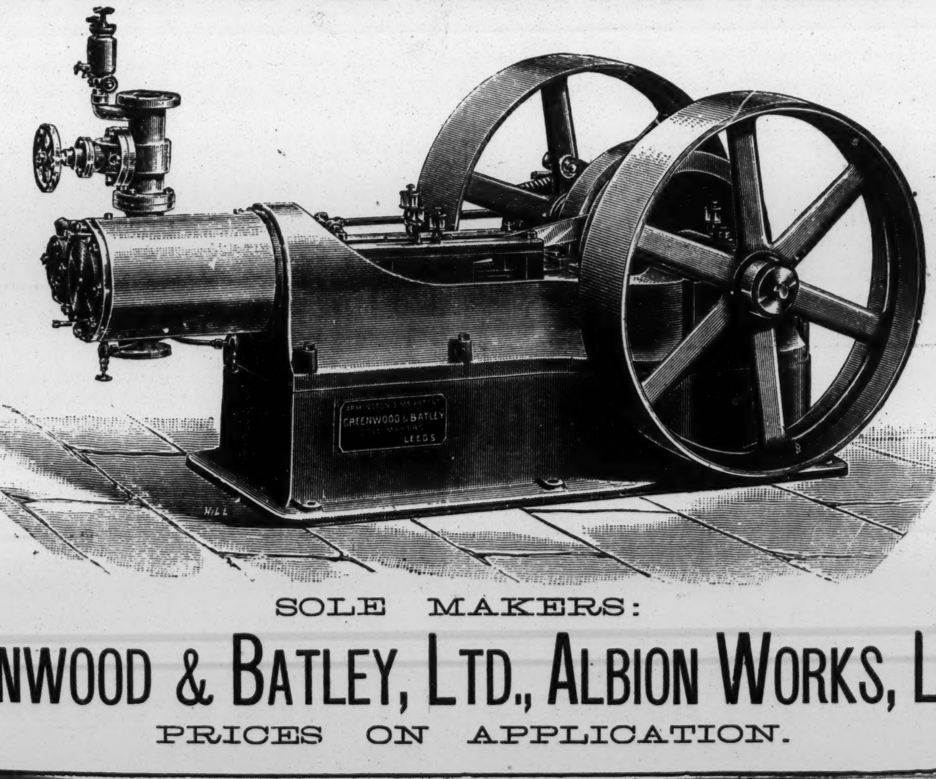

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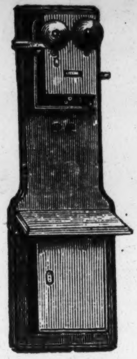

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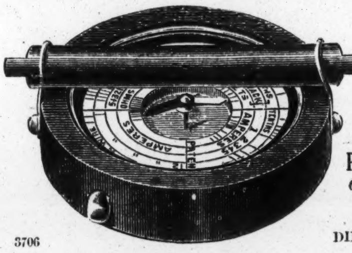

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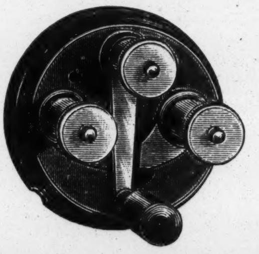

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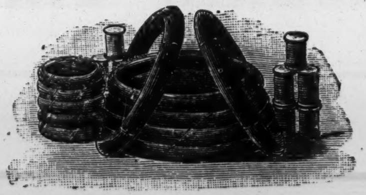

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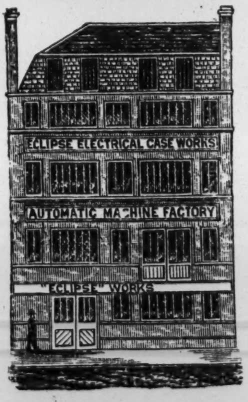

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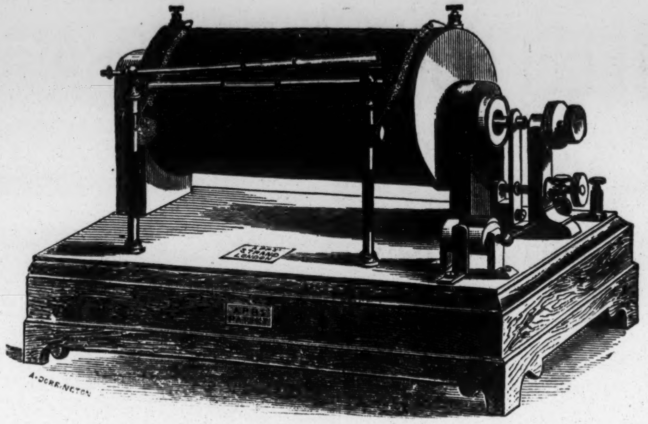

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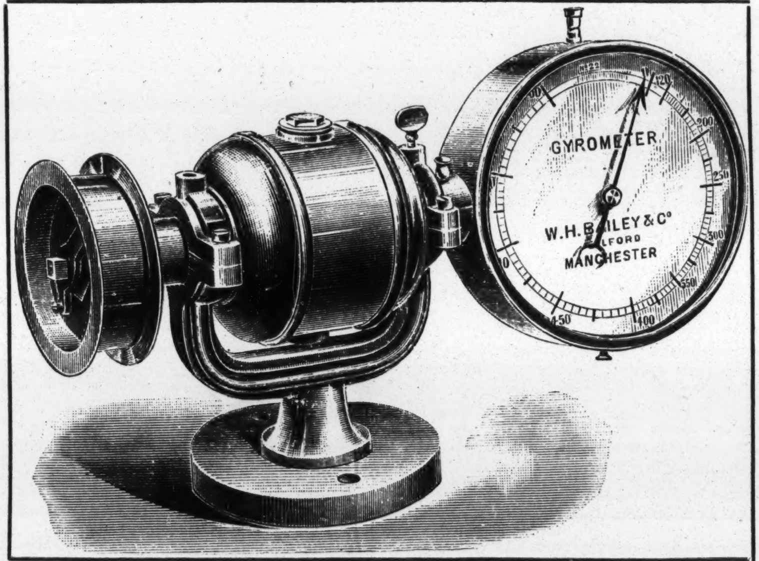

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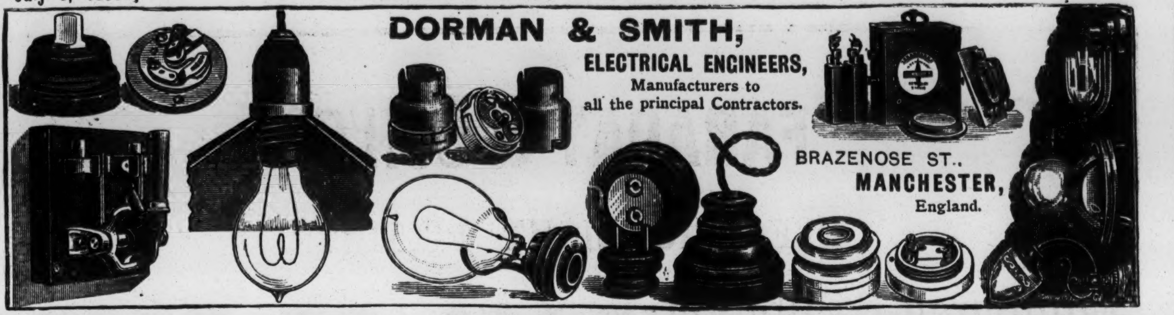

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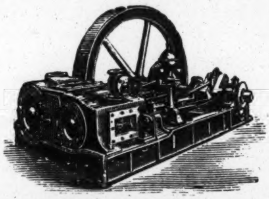

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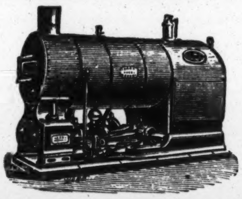

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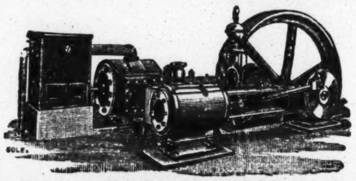

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THE INTERNATIONAL OKONITE COMPANY, LIMITED.

"CERTAINLY the person who is able to rate at their true worth the statements in prospectuses is very rare. We have no time to go to Vancouver's Island to learn whether the coal from there has the alleged percentage of carbon, and we should be no wiser if we went. We are not accountants; we must take for granted as true the assertion that the output or turnover was such-and-such, and the reserve fund is so-and-so. No one questions all this, so far as direct positive averments are concerned. . . . There is the cleverly drafted, skilfully baited prospectus; no one can lay a finger upon a phrase therein personally pledging anyone concerned in issuing it. . . . Anybody who cares to inspect contracts, more or less intelligible, . . . may find out the facts for himself. Everyone knows that there will be no such examination. Subscriptions will be made solely on the strength of the names of the directors or promoters. They are the bait, and they know it."

We quote the above from an article entitled "Limited Liability in Morals," in our political and critical contemporary, the *Speaker*. To those interested in the subject we can recommend the perusal of the entire article, which appeared in the issue of Saturday last.

On Monday was published the prospectus of the International Okonite Company, promoted by Woodhouse and Rawson United, Limited, one of whose directors (Samuel Pope, Esq., Q.C.) is on the board. The other directors are Lord Greville (chairman of Eastman's, Limited, a recent Stock Exchange success which it is of value to mention); Sir Alexander Armstrong; H. Dobree, Esq.; Major Charles Jones and Sir William Davies; Sir Rawson Rawson and Lord Aberdare being trustees.

At the head of the prospectus is a statement of the average dividends paid for the past 6 and 13 years respectively by, and the present market price of the shares of, the Silvertown Company and the Telegraph Construction and Maintenance Company. The capital is £340,000 in shares, and £100,000 in debentures, and the object is to purchase and extend the businesses of the Okonite Company, of New York, and Messrs. Shaw and Connolly, of Manchester. Okonite is described as "a valuable compound prepared and applied by special processes," and there is a statement of the manifold virtues which the Okonite Company claim for their products. The prospectus, as advertised, does not detail the reports of Sir Wm. Thomson and Dr. Hopkinson; but it states that it is "*mainly* on account of the high qualities of okonite wires and cables that they have consented to accept the responsible post of consulting engineers to the company." There are evidently other considerations, but they take quite a secondary place.

Then follows a description of the American factory, with particulars of its water-power and rental therefor; an accountant's report, which shows that the company has done a very satisfactory business for the past three years, with a remarkable increase in the last one. A momentary divergence takes us from accomplished facts into the region of "estimates," to which we need not now refer, as we have a larger instalment later. Mr. F. L. Rawson, having been sent out by the vendor company, reports that from "information he obtained," and persons he saw, he "became convinced that the business was of high class, the works and products excellent, and those connected with the company were men of probity and commercial standing"—a gratuitous testimonial which we hope they will appreciate.

The English business is acquired on the guarantee that the books, "when examined by the company's auditors shall give the results stated by" the proprietors to the directors, *i.e.*, over £4,000 last year, and for this year *at the rate of* £6,000 per annum. Considering the detail with which the American profits are set forth, and the certificate thereon, there is something wanting in the statement relating to the English business. "The company's auditors" took steamer for New York, or the New York books were sent to London. Why couldn't they take the train to Manchester, or the Manchester books be sent to them? What is the nature of the "guarantee?"

There are the usual baits of probable subsidiary companies, and powers to pay interim dividends.

After particulars of management, its complicated remuneration, and a statement that the present holders of the business have agreed to retain £100,000 worth of shares for four (with such prospects the wonder is they do not make it forty) years, there is given in considerable detail an estimate of future profits, which "is based on the information supplied by the Okonite Company of America, and Messrs. Shaw and Connolly, to the directors." Estimates are given separately for the present and three following years, according to which the debentures are always to get their 6 per cent., the preference shares their 8 per cent., and the ordinary shares their 15 per cent., with occasional bonuses in addition for everybody but the poor debenture holders, leaving surpluses of a very improving character, which are conveniently summarised, and go towards an extra bonus. We think this extra bonus sufficiently shadowy to render it unnecessary for us to set it forth in detail. The purchase price has been fixed at £224,990—£113,330 in shares, £33,300 in debenture, and £78,360 in cash. The average profits of the American business for the three years is £14,000 per annum. There is no material for an average of the English business, but taking the figures "guaranteed" for last year's profits (£4,000), we have £18,000 per annum for the profits of the combined businesses. The company purchases these at the rate of 4⅓ years' purchase in *cash*, 1⅝ years' purchase in *debentures*, and nearly 6⅓ years' purchase in *shares*; altogether about 12½ years' purchase. Or, if we do not take an average, the purchase price is at the rate of eight years' purchase on the business of 1889.

It seems to us the directors might have omitted some of the matter in the prospectus in order to find room for expert testimony that 12½ years' purchase on the average of three years' business, or eight years' purchase on one exceptional year's business, is a fair and reasonable rate; or they might have profitably stated that if they were buying the businesses in their private capacity they would have jumped at the opportunity.

We do not overlook the fact that the purchase includes such tangible assets as buildings and machinery, as well as such intangible ones as processes and goodwill. We should have preferred to separate the wheat from the chaff, but the prospectus does not give us an opportunity of doing so. We have not deducted anything on account of patents, though the new company purposes providing £1,000 a year for depreciation. No details are given regarding these patents, so that we cannot form any idea whether the American Company is right in deducting nothing, or the English Company making unnecessary sacrifices in deducting too much.

Under the circumstances, it may be matter for regret that over £110,000 is left for "working" capital.

The accountants "examine and report," the experts "report," Mr. Rawson "becomes convinced," the Okonite Company "claim," Messrs. Shaw and Connolly "guarantee," and "estimates are based on information." With all this, however, are the directors free from responsibility? We think not. What is the general effect produced on the average investor unfamiliar with electrical enterprises by a perusal of the prospectus? Being told that the India-rubber Company has paid an average of 13 per cent. during the last six years, is he expected to enquire whether it has always paid that munificent dividend? When it is stated that the Telegraph Construction and Maintenance Company has paid 20 per cent. per annum for a number of years, is he to assume that the Okonite Company starts with the same valuable connection? Do the directors wish him to understand that the Okonite Company either can or will be engaged in a similar business to either of these companies? When an estimate of future profits is given in such detail as to occupy, more or less, 100 lines in the *Times* newspaper, and contains the important "Note" that "the calculations of dollars into pounds are made at $4.85 to the £ sterling," is the intelligent Briton expected to arrive at the conclusion that the estimate is purely imaginary and absolutely valueless, or is he expected to be impressed with "15 per cent.?"

The promoters and directors cannot shift the responsibility for the publication of such an estimate and the inference to be drawn from it. Mr. Samuel Pope, Q.C., in his capacity of Chairman of the English Association of American Bond and Shareholders, has surely had some experience of disappointed hopes in limited companies. Sir Alexander Armstrong has been connected with some electrical concerns. He might perhaps give his colleagues some information bearing on the question of estimates and results—the relation of prospectus to performance. The directors, as a body, must be aware that businesses have their ups and downs. The Okonite Company has had its ups—very good ones. Is it absolutely impossible that there should be an alteration in the direction of the curve? Is it possible that the sale to, and management by, an English company may in any degree affect the continued successful working of the American business?

We are not concerned with the quality of the material itself. The development of the American company would imply that either it must have some considerable merit or the business have been well managed—perhaps both.

Placed upon the market in a business-like manner, we would have heartily welcomed Okonite. As it is, we can but condole with it in its misfortunes. To be expected to pay a dividend on a capital of £440,000, with an expensive organisation and ornamental directors, would appal many better substances than Okonite. We hope it may be equal to the occasion, and that our fears of disaster for the company may be mistaken.

We think that the shareholders of Woodhouse and Rawson should recognise the value of the permanent staff in carrying on what is generally understood to be its "legitimate" business, for we do not see how the directors and managers can well spare for details any of the time which must needs be occupied in the promotion of companies from copper-deposition to co-operative stores. With the interest of the electrical trades at heart, we would suggest to them the selection of one or other *rôle*—electrical supplies or company promotion. We fear they will find that the combination is not consistent with sound business on a permanent basis. If they should decide to give up the company promotion department, we should not regret it. We have no desire that electrical affairs should be placed before the public in a form which is at least misleading, and which must almost inevitably produce disappointment to the investor and detriment to the electrical profession.

A correspondent sends us the following :—

"Full information is given in the prospectus as to the business of the two concerns, and the opinion of an expert is quoted as to the desirability of acquiring the American business with the view to its extension by means of a company. The expert who went over to the States to examine into the value of the manufacture of okonite and the business of the concern is, I learn from the prospectus, the managing director of the company who are now promoting the new undertaking.

"The profits of both undertakings are given during the past few years, and the estimates of the future profits are given on a considerably-increased scale, and the dividends to be derived are fairly compatible with the case if *no other wire* but okonite was ever used. There is one point in the estimates of the future profits I should like to draw attention to, as it has an important bearing upon the actual amount which should be realised. In the prospectus it states, 'there is every reason to believe that in the near future, when okonite covered wire can be obtained in England for home consumption and export to other countries, the profits from the English branch will equal, if not exceed, those of the American.' Okonite wire has been before us in this country, and of late has been pushed forward by a well-known firm, and, I believe, its use has been extended ; for all this portion of the business and its increase the American factory turns out the wire, and the present and future profits are credited to the American factory, not only now, but in the future. The okonite wire will soon, according to the prospectus, be manufactured here, and the business is expected to be large ; the English profits are therefore increased by the home consumption of home-manufactured wire, instead of obtaining it from the States ; but no alteration has been made in the prospective profits, on account of the American branch losing all the British, and, probably, European trade. In fact, the American branch is calculated to yield an increasing profit on business now shipped here, which will, according to their own showing, be taken away from them by the English factory.

"It may not be valueless to point out that the company is formed to acquire the business of the Okonite Company, and to extend this special insulation. The patents in connection with this wire are for various modes of manufacture, and the material called 'okonite' is a compound in which rubber plays the most important part ; the combination is a secret, and is therefore valueless from a monetary point of view."

OVERHEAD TELEGRAPH WIRES.

THE small majority of three, by which the London Overhead Wires Bill was recently rejected, seems to show that opinions on the subject are pretty equally divided, and that it was a mere chance that turned the balance against the measure. The Bill conferred upon officials of the London County Council powers of compulsorily entering upon private property at any time for the purpose of putting up wires and inspecting them ; and, with the usual exaggeration, many of the speakers drew pictures of the terrible and outrageous infringements of private rights which would ensue if freedom of access were given to workmen to the roofs of houses to place new poles or repair wires. One member stated that since he had given a telephone company permission to put a wire over his house, it "had never been his own. The inspectors were always in and out, his stair carpets were worn, and his silver had to be constantly locked up for fear it should be stolen. The poles, moreover, were fixed so badly, that considerable damage was done to the roof of his house. The company declined to repair the damage, and it cost him £50 to put the roof in order when he applied for the removal of the poles. To that inconvenience every person would be subjected who had wires fixed to his house, and he protested against its being done whether an owner or occupier objected to it or not. The question was not one of erecting telephone wires, but of electric lighting wires, with the erection of which they were threatened all over London, and which was a very much more serious matter. They were in the infancy of the system, and yet they had already realised that those wires greatly increased the risk of fire, a proof of which was that the insurance offices had raised the rates for that property to which electric lighting wires were fixed."

We cannot but believe that the hon. member's statement is an exceedingly highly coloured one, though it may have some foundation in fact; but even granting that it is correct in the main, there ought to be no difficulty whatever in so amending the Bill that such inconveniences as those described should be reduced to a minimum. It was also stated that workmen claim the right of access at all hours to a roof where a telephone pole is fixed ; and, further, that the Bill would empower the Council's officers by day or night to enter into private houses. With reference to this, it was pointed out that one of the great dangers of the overhead wires was that there were in London a great number of derelict wires, and therefore it was most necessary that workmen should be appointed by the local authorities to deal with the wires. Clause 8 of the Bill provided that the inspector of the Council might enter a private house provided he were in uniform, and duly authorised in writing by the local authority, and provided that notice had been previously given. The inspector might then enter at some reasonable time to be named by the occupier. The rights of householders are thus most stringently guarded.

The great objection to the Bill was that power was given to put up a pole against the will of the owner of a house; but, as Mr. Courtney pointed out, the clause empowering this to be done could be struck out, but it was entirely a different thing to oppose a Bill which was admittedly a useful measure; this reasonable argument, however, did not appear to have much weight, and, for the present, things are to remain as they are.

Primary Batteries.

SOME of our contemporaries have commented upon M. Weymersch's primary battery without apparently perusing the report upon which their remarks are ostensibly based. One compares the cost of producing electricity from galvanic elements with that of central stations, and the result is naturally against the battery; furthermore, for the manipulation of the apparatus, it is contended that a new form of domestic servant must be forthcoming, although in reality the duties attached to filling and emptying the cells are but little more onerous than those entailed in a bath room. To say that the everyday attention required for a battery of this type is quite beyond the resources of small houses is altogether erroneous, and simply shows that the writer is not acquainted with the means adopted to reduce the labour and time employed on the battery to a minimum. In another important exchange it is stated that "though only intended for use where steam power is not available, the Weymersch battery gives results almost comparable with steam engine and dynamo." How this conclusion was formed we know not; certainly the report does not lead to such a belief; but perhaps the plant with which our contemporary is best acquainted is expensive to maintain. At all events the report seems to have been passed through a "Hedgehog transformer;" in no other manner can we account for the impression which was produced in the writer's mind.

The Rival Systems.

THE comparison of the battery *v.* the steam engine and dynamo, brings up another question, one which we discussed at considerable length in our leading columns for June 20th. From figures which have been sent to us, it appears that an average of 17 to 18 lbs. of good coal is used in alternating current stations per net unit sold; whereas the amount necessary in supplying the continuous current on the three wire system, with or without accumulators, is just about half, viz., from 8 to 9 lbs. Furthermore, we are assured that the total cost of engine room expenses, which includes fuel, water, petty stores and wages, was, in the case of a West End company, averaged throughout last year, a trifle under twopence per unit for the continuous current supply. The figures for another station, working alternating machines and transformers, averaged for the best three months of the year, showed the cost per unit to be over sevenpence; and in another instance, that of a provincial station, over ninepence. Summing up, the data placed in our hands leads to the conclusion that at the present moment the companies working continuous currents, with or without accumulators, are producing electrical energy in the engine room at less than twopence per unit, whereas in the case of alternating current stations, the average appears to be over sevenpence. It seems almost impossible that there can be such a difference between the cost of production in the respective systems, but our informant stands so high in the profession and has had such great experience in central station working, that we hesitate to think he has made a mistake; the matter, however, is one demanding serious consideration, and we shall be glad to learn that the cost given for alternating working is open to modification, for unless we know all the circumstances and conditions of supply, the steam engines employed, the kind of drive, and, above all, whether the station considered as a whole, or the factors of which it is composed are working up to their full capacity or only partially loaded, the figures can scarcely be accepted *in toto* as fairly representing the merits of the two systems. Perhaps the London Electric Supply Corporation will favour us with an analysis of its working expenses!

The French Submarine Cables.

THE Direction General of the French Posts and Telegraphs is much occupied at the present moment with the establishment and repair of telegraph cables. In concert with the Post Office, the Administration is considering the laying of a new cable between London and Paris. M. Selves has also submitted for the approval of the Minister of Commerce a report on the defective condition of telegraphic communication between Tunis and Algeria. The attention of the Director-General has been called to this state of affairs by the Governor of Algeria and the French Resident General in Tunis. In reality, the State only possesses three Franco-Algerian cables. One of these was laid in 1871 and works in very bad condition, the other not being much better. The third alone works well, but is not sufficient to ensure the service. The sole solution consists in the laying of two new cables uniting Marseilles to Tunis and Oran. It is in this sense that M. Selves has drawn up his report and asks the Minister to get the Chambers to vote the credits necessary for the immediate laying of these cables. M. Selves has also asked M. Jules Roche to obtain other credits with a view to improving telegraphic communications with Corsica, the defectiveness of which was so much remarked upon during the tour of the President of the Republic.

Smoke Abatement.

THE "smoke annihilator" invented by Mr. Samuel Elliott, of Newbury, and to which we called attention in our last issue, may do all that is claimed for it, but no data is to hand as to the cost of and power demanded in working the apparatus, or its reliability; neither have we seen a report upon it by anybody claiming to be an authority in mechanical engineering matters. It is an easy thing to get together a heterogeneous assemblage of individuals who, without being at all acquainted with the process they are invited to view or of its mechanical details, are always ready to pronounce the apparatus capable of effecting a revolution in any industry to which the inventor intends it to be applied. Until some details of its performance outside the inventor's premises are available it would be unwise to express any definite opinion on the subject; at the same time we hope that Mr. Elliott's sanguine anticipations will be realised.

The Electric Lighting Acts.

A WELL-KNOWN electrical corporation has registered several local companies with nominal capital for the purpose of obtaining provisional orders under the Electric Lighting Acts. Lest any misapprehension should exist as to the policy of this move, we may mention that it is rendered necessary by the attitude which has been taken up by the Board of Trade in practically declining to allow a provisional order to be assigned. In the places where the corporation has applied for provisional orders it has definite and valuable interests to protect, and if it had not so applied in these places it would incur the risk of losing its rights there. It must be obvious that it is not practicable for a manufacturing and contracting company to permanently work provisional orders in a large number of provincial towns, and as the Act also provides that the undertakers shall in the case of each provisional order keep separate accounts of the undertaking, it is advisable for these reasons alone to register in each place, where there are interests to protect, a local company with a nominal capital, to be increased as circumstances require.

Experts' Opinions.

IT is admitted that the Blackpool Electric Tramway has been a commercial success, but this has been attributed by experts in some quarters to the fact that the town is a summer pleasure resort, and that therefore the same happy financial state would obtain with horsed cars. Probably the majority of tramway men consider that the best paying lines are those having a regular traffic, so it is easy to show that the opinions to which we refer are mistaken ones. At Blackpool during winter not more than four cars are run, the mileage being only 45 per car day, whereas in summer eight to ten cars are employed, each with a daily run of 52 miles. To meet these conditions with horses would necessitate buying them when dear and disposing of the bulk of them when cheap, or keeping them in idleness and eating their heads off during the cold weather. How great the actual difference really is can best be shown by an incident which occurred during the summer of 1877. A breakdown occurred in the insulation of the line and horses were hired from one of the large tramway companies in a Lancashire town. During the month when horses were employed, the average cost per week was £113, but during similar periods of time previous to the hitch and since, the electrical working cost has not exceeded £45. It may be urged that using one's own animals would cost less than when depending upon the hire system; still the enormous difference between the figures above quoted must conclusively refute the statement that Blackpool would be as commercially successful if worked by horses.

Accumulator Traction.

A WELL-KNOWN engineer points out that though accumulators have been in the hands of capable engineers, backed with almost unlimited capital, still no system of working tramcars by these storage cells exists that can be shown to pay. To contract at a price is one thing; to make the business pay, except by disposing of it to someone else, is another. The Elieson Company, says our authority, found its 4½d. per car mile contract cost nearly three times that sum, and the Brussels company, after a lengthened period of apparently successful running abandoned the method, because, as the chairman was reported to have said, "the system failed commercially on every point." Can any user of storage batteries show a set of cells which have been in daily use for tramcar work for 12 months and that are still in good condition?

The Cost of Electric Haulage.

WHILE upon the question of the cost of various electrical tramways, would it not be well if some systematic and generally accepted scale could be determined upon so as to show definitely what items should or should not be included under cost of haulage. There are not so many conflicting interests in this country at the present moment but that this problem could be readily solved.

Business Men Interviewed.

A REPRESENTATIVE of the *City Leader* has interviewed Mr. Joseph Smith, the managing director of the Electric Construction Corporation. The interview lasted but 10 minutes, but in that brief period a number of stupid questions were answered in such a manner that it is no wonder electric traction hangs fire in this country. What a lucky thing for the readers of the *City Leader* that Mr. Joseph Smith limits his conversational powers to just the sixth part of an hour.

The Tramways Institute.

THE Tramways Institute of Great Britain and Ireland held its annual meeting on Wednesday, at the Westminster Palace Hotel. The proceedings were remarkably dull until the reading of two papers on electric traction, when a lively discussion took place regarding the Barking line. We hope to deal with this subject in our next issue, especially as one gentleman advanced figures to show that the line was a failure from a commercial point of view. Yesterday (Thursday) some of the members visited the Barking Electric Tramway.

Seeing by Electricity.

WE are pleased to notice that the *Standard*, in describing the Celebration Jubilee of the Penny Post, alludes to the labours of the late Robert Sabine in the direction of "seeing by electricity." His experiments with selenium are probably now known to but few, and it is not difficult to identify the *Standard's* representative.

Burnand's New Burlesque.

MR. F. C. BURNAND has written to the *Times*. He has a grievance against the K. and K.E.L. Company, because its employés dig up the streets and pathways for the purpose of laying mains. We consider that the gentleman has little cause for complaint, and the company might give him a *quid pro quo* for allowing such feeble matter as sometimes disfigures the pages of *Punch* to appear under the guise of wit and humour.

FRENCH NOTIONS ON ACCUMULATOR TRACTION.

PERSONS who are either directly or indirectly interested in the development of electric traction, especially on the accumulator system, which appears to be, as yet, the best system applicable for urban and suburban traffic, are always seeking for data regarding, not only the initial cost of installation, but also as concerns the cost of renewing the plates of the accumulators, the amount of money for the depreciation of the motors, gearing, &c., the actual working expenses at the charging station, and the depreciation of the plant therein installed. No trustworthy details, with the exception of the first item, can be obtained in this country concerning these expenses, and time alone will bring forth the results. Everything, at present, is based upon estimates which are of no earthly use; absolute facts only are required. In this connection it is interesting to note that the estimate mania has arisen in France.

In the course of a few weeks there will be published in Paris a work which has been prepared by M. Paul Gadot, of accumulator fame. This gentleman's book establishes, or pretends to establish, a parallel between animal traction and electric traction by means of accumulators on tramways. The question in the two cases is the working of a tramway similar to those in Paris, the cars, cost of working, traffic, &c., being taken into consideration. The author presents three projects to solve the problem of electric accumulator traction. The first refers to that in which the accumulators are carried in the car itself; the second where batteries are independent of the car and are carried in a special car or waggon; and the third to cells arranged in a special waggon which also carries the driver, this being termed the electric locomotive.

M. Gadot extols the second system, which, according to his opinions, ensures the independence of the cars and accumulators, diminishes the working expenses, since the batteries are no longer put into place, or removed by hand one after another, in order to be recharged; and the cars do not have to be taken back to the depôt to receive a set of freshly charged cells as they stop at the terminus where special cars containing newly charged cells are kept in reserve.

The *Bulletin International de l'Electricité* thinks that such a system would be objectionable, owing to the increased length of the car, and to the consequent interruption in traffic. Our contemporary might have added that such a system would necessarily augment the dead weight to be hauled.

From a financial point of view M. Gadot considers all possible combinations, and concludes in favour of electric traction, as follows: "We will suppose that the traffic is carried on by cars of the General Omnibus Company's type, each carrying 50 passengers and weighing 3 tons 7 cwts. when empty, and 3 tons 13 cwts. being the weight of batteries, motors, gearing, &c., making a total of 7 tons. Each car would travel daily 62 miles, and the average power developed is about 23 lbs. per ton. (?) The number of cars should meet the requirements of the omnibus company.

"In the first system suggested, by changing the cells three times a day, they are not quite exhausted, and the cost per car-kilometre comes out at 4⅞d., or 7⅞d. per car mile. In the second system the special car containing the batteries is changed three times daily, and the cost per car-kilometre is also 4⅞d., or 7⅞d. per car mile. In the third system the cost per car-kilometre is higher than in the two previous cases. Turning to the cost incurred by the Compagnie Générale des Omnibus de Paris for horse traction per car-kilometre, M. Gadot states that it amounts to 5⅝d., or 9d. per car mile. This, then, is more than one penny per car mile in excess of the estimated cost of electric traction. Now, contends the author, from the fact of the reduction in the *personnel* of the company by the adoption of electric traction, by the letting out on hire or the sale of the premises which would not be required, such as stables, granaries, &c., the Compagnie Générale des Omnibus would be able to reduce its capital by nearly £310,000!"

M. Gadot appears to neglect the most simple system of carrying the accumulators under the car seats, and the motor and gearing under the body of the car, for the complicated and certainly more expensive system, both as regards initial expenditure and maintenance, of employing a second car to carry the accumulators. This has been so demonstrated by the Stratford *fiasco*, although the system there employed was slightly different to the author's favourite, but it corresponded to the third method suggested by M. Gadot. Then, again, the cost of maintenance and depreciation of plant appear to be left out of the question. Taking the estimated cost of renewals alone at from 1d. to 1½d. per car mile, or a mean of 1¼d., the cost of accumulator traction in Paris would exceed that now incurred for horse haulage, and the estimated reduction of the capital of the Compagnie Générale des Omnibus by nearly £310,000 entirely vanishes, although a saving in stabling, &c., would be effected. M. Gadot also leaves out of consideration the drivers' wages, &c., both as regards horse and electric traction. If he could furnish reliable data concerning the four accumulator cars which have been running for some time on the Madeleine-Levallois line of the Compagnie des Tramways du Nord, in Paris, M. Gadot would render great service to the electrical profession, who do not require, and will not accept, bare estimates on electric traction. In the meantime, we do not see the utility of a treatise containing estimates and devoid of facts.

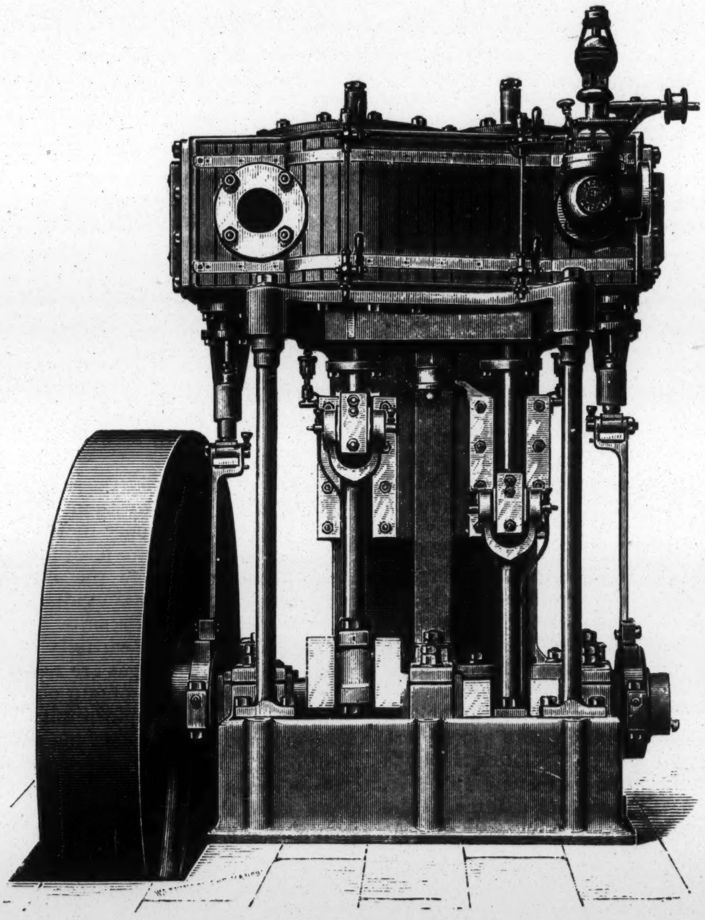
THE GAS COMPANY AND THE ELECTRIC LIGHT AT BUDAPEST.

[FROM A CORRESPONDENT.]

THE question of the electric light at Budapest seems on the point of developing into a genuine sea-serpent, and if, after my repeated reports on the different phases of this affair, I refer to it again, it is merely because I consider it instructive for the widest circles, and consequently also for your readers, in so far as many municipalities which are in the same position as Budapest as far as lighting is concerned may learn from the proceedings there what a city ought *not* to do if it wishes to defend its own interests.

In my former reports I have already explained in what a peculiar position the city of Budapest is with regard to the existing gas agreement, as the gas company, up to 1891 inclusive, has the exclusive right of utilising municipal territory (streets, lanes and squares) for any lighting purposes whatever. Now, instead of looking out betimes that the city after the expiry of this monopoly should at once enter into the actual enjoyment of the recovery of its freedom of action, the city has for some years allowed itself to be led astray by the gas company, which, according to circumstances, boasting partly of alleged agreement rights and partly professing a benevolent readiness on its part, has with refined craft hitherto succeeded in keeping back the city from a definite decision on the lighting question, and in this manner to postpone the grant of a concession for the erection of electric works at Budapest. After the gas company first emphasised its—merely alleged—right by agreement, according to which negotiations with other lighting companies could be undertaken only after negotiations with the gas company, and after it had attained its purpose of protracting such negotiations as long as possible, it declares itself willing to take the electric lighting in hand (naturally!) and to enter into negotiations to that end with the municipality. As a matter of course, during these discussions the negotiations already entered into with other parties were broken off, and the gas company could again say to itself, "Time won, everything won." When, then, the gas company, after a considerable time, thought it prudent again to move in the matter; it declared that it would magnanimously give up its monopoly (which has only two years to run) and make a few other concessions if the city would prolong their gas agreement for 15 years more. At the same time the gas company demanded that the question of electric lighting should be decided in the way of a *public competition*. The invitation to this competition, of course, could only be given after the formal conclusion of the negotiations with the gas company, which, it was to be foreseen, would be very tedious, and the company well knew how long electrical works have to be waited for if they are to come into execution as the results of such a competition.

The City of Budapest in the meantime, which fancied itself at last at the goal of its wishes, accepted in principle the proposals of the gas company, and merely demanded the acceptance of a few further conditions which have been already communicated in your paper.



A few days ago the reply of the gas company was received, which in the most important points is in the negative! Now the negociations may begin again, for the city thought that it merely needed to ratify the application for a concession which had been made years ago from another quarter, and had been already discussed by the municipal commission of lighting, and accepted in principle, in order in a short time to come into the possession of electrical works.

Meantime the Mayor of Budapest set off to Paris in order to study there electric lighting, with a view to utilising at home any observations which he might make. This is simply carrying coals to Newcastle, if we remember that the most important towns and lighting installations of the Continent have repeatedly sent representatives to Budapest, in order to study electric lighting there.

The gas company has, therefore, once more succeeded in preventing for an indefinite time the erection of electrical works at Budapest, and, without doubt, it has reached this object by an expenditure of cleverness which must be admitted. Whether this skilful management has been really prudent is another question. We see that many other gas companies, *e.g.*, the Società Anglo-Romana at Rome, and the Innsbruck Gas Works have secured and promoted their interests in an effective manner by erecting electric works, and uniting the two kinds of illumination in their own hands.

THE "CENTRAL STATION" VERTICAL SIDE-BY-SIDE COMPOUND HIGH-SPEED ENGINES.

THE annexed wood-cut represents a type of vertical compound engine, made by Messrs. Browett, Lindley and Co., which has become deservedly popular for electric lighting on account of the small floor space occupied for any given power, as well as for the simplicity of its construction, the steadiness of its working, and the high speed at which it can be run, thus dispensing with countershaft and large flywheel. In addition to these advantages all parts are easily accessible and removable for necessary examination and repair when worn.

The crank shafts are of mild steel, forged in one piece, most accurately finished in all parts, and well supported in three main bearings, of large proportions. The cylinders are cast of hard, close grained iron, and securely bolted to the vertical frame. The pistons are constructed on the most approved method, and fitted with broad cast iron rings, expanded by steel spiral coils.

One of the most important improvements in detail is the construction of the piston rod and cross-head, which are forged in one piece of steel. This consists in cutting out the cross-head, so as to receive the brasses from the front, instead of from the bottom, and tying the jaws together by a solid steel cap, lipped over at each end, and bolted to the face of the cross-head by two turned steel bolts passing right through it, and serving also to secure thereto the broad cast iron slipper which rides on the slide face, the whole being screwed up tight, metal to metal, and the nut secured so as not to shake loose. The strain of working is thus not borne by the bolts, and these require no adjustment, the brasses in the cross-head eye being set up by separate screws actuating a broad wedge, and providing an ample metal to metal surface at this most important joint. The joint was invented by the makers, and has been used in all their electric light engines for years.

The well-known "Acme" patent governor is used on these engines, ensuring the greatest regularity under all variations of load, but automatic expansion can be provided when required, by using an improved drum governor on the shaft controlling the cut-off direct. For the higher pressures of steam, now in vogue (120lbs. and over), piston valves are provided on the high-pressure cylinders to reduce the wear and loss in friction.

BELT STRENGTH.

By ROBERT GRIMSAW, PH.D.

THE problem often presents itself how to figure out in a moment whether or not a certain belt is strong enough to carry a certain horse-power at a certain speed. It is always well not to strain a belt, and sometimes there is not only danger of ruining the belt but a chance that breakage may work damage to business or property.

We will suppose that the belt is a leather one, running upon a cast-iron pulley. We know that the pull it exerts on the pulley is equal to the strain upon its tight "side," or fold, less that upon the slack side, or fold, and that this pull in pounds, multiplied by the belt speed in feet per minute, and divided by 33,000, will give the horse-power. (This is assumed as correct. It is true, and there is no time to prove it now.)

Of course leather varies in strength; and no matter how strong the belt is, if the lacings or other fastenings are weak, the belt will be in danger. The greatest strain upon the belt, in pounds, is equal to the breadth of the belt in inches, times the thickness of the belt in inches, and times the safe working strain per square inch of cross section of the belt; this latter depends upon the kind of leather and upon its fastenings.

As to these fastenings, it is safe to assume, as the result of experiments made, that for ordinary single leather lacings the average breaking strength is 950 pounds per square inch; single rawhide, 1,000; double leather, 1,200; double rawhide, 1,400; and riveted joints, 1,750.

Of course the safe working stress in pounds per square inch will be less than this; and we may put them about as follows: single leather lacing, 325 pounds; single rawhide, 350; double leather, 375; double rawhide, 400; and rivets, 575.

Working from this we find the square inches cross section of the belt to be for belts which are single leather laced 1-325, the greatest tension; where they are laced with single rawhide, 1-350; with double leather, 1-375; with double rawhide, 1-400; and where they have riveted joints, 1-575.

Thus, if we know that we are going to use a single leather-laced belt $\frac{1}{8}$th inch thick, and that it will have a force of 500 pounds on the pulley, and that the arc of contact will be 105 degrees, we know that the greatest strain on the belt will be $500 \times 1{\cdot}93 = 965$ pounds; and dividing this by 325 gives practically three square inches of cross section needed. As the belt is to be $\frac{1}{8}$th inch thick, it would need to be $3 \div \frac{1}{8} = 18$ inches wide. If it were $\frac{1}{4}$ inch thick it would need to be only $3 \div \frac{1}{4} = 12$ inches wide; and if $\frac{1}{3}$ inch thick, only $3 \div \frac{1}{3} = 9$ inches wide. For every arc of contact there is required a different multiplier; these are got from tables which have been calculated by correct theory and proved by accurate experiment. Thus, for 30 degrees arc of contact the amount of pull upon the pully is 0·189 times the greatest strain on the belt; for 60 degrees it is 0·2967 times; and so on, according to the following table:—

Arc of Contact.	Multiplier.
30°	0·1890
45	·2695
60	·2967
75	·4082
90	·4673
105	·5181
120	·5650
135	·6098
150	·6494
165	·6803
180	·7143
195	·7409
210	·7692
240	·8130
270	·8475
300	·8772

This table (from the *Electrical World*, which is here published for the first time) is very convenient for ready reference when it is desired to know how much actual drive can be had out of a belt having a given breaking strength. Thus if we have a leather belt the safe-breaking strength of which is 1,000 pounds, we may know that all the pull that it can be made to put upon a cast-iron pulley, with 90° arc of contact, will be $1{,}000 \times {\cdot}4673 = 467{\cdot}3$ pounds; but if the arc is 180° we will be able to get 714·3 pounds pull with the same maximum strain upon the belt.

THE MANAGEMENT OF ACCUMULATORS.*

By J. K. PUMPELLY.

IV.

IT was discovered by Planté, and by the experience of others since, that many more hours of discharging are needed to convert the positive plates into a peroxide of lead than to change the negative plate into finely divided lead, which is evidently the process necessary, as far as practical results go, to make the battery efficient to its full capacity. To do this, one or two charges and discharges are necessary, so that in reality we cannot expect to obtain our estimated percentage of efficiency until this forming work has been done, by the current of electricity put into the battery and taken out of it. Let us suppose now that this has been done three times consecutively, then we make our test trial. We have the 30 batteries and a series of 10 60-volt lamps connected, and we find that these 10 lamps are burning well up to candle power for seven hours; that is, 70 ampère hours have been consumed, and the voltage of the battery stands at 58 volts. Hence the lamps will burn two hours and a-half more, making 95 ampère hours of useful work, but not with as high candle power. Now we find it best to take off the lamps, leaving about 20 per cent of the charge still in the battery. This method is preferred, as it seems to prevent the action of the sulphuric acid directly on the lead plates, and also shortens the time of the next charge. Now we charge again with a current of 20 ampères, and find that after five hours' run in discharging on 20 lamps we have about the same efficiency as before. Again we increase the charging current to 20 ampères, and the discharge to 30 lamps, and find a slight loss in our heretofore fair percentage. Hence we conclude by experience that a 25-ampère charging current is sufficient for a 100-ampère hour battery, and the discharge is not economical over the rate of 20 ampères per hour. This rate of charge and discharge we will call normal. A larger rate of either we will consider maximum. We get quicker work, which is supposed to be needed, but not so economical as to efficient percentage. If it should happen that the charging current was not cut off at the end of five hours, the current that still flowed through the battery would be of no good nor do any harm. It would be like splashing water over the top of a tank after it has been pumped full.

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* *Electrical World.*

In watching our next charging, we may find that one cell in the series does not act like the others. The surface of the electrolyte remains quiet, and no bubbles appear on the surface. We try the voltmeter on the circuit, and find that we are two volts short; instead of a fraction over 60 volts we have but 58. We must try every cell, using the double reading on our Weston voltmeter, which is divided into thirtieths and has a double-pole standard or connection fastening one wire to the small standard and one to the larger one. This will give us the reading on the lower line for two or four volts and thirtieths of a volt. Now we must find out, by testing each cell for voltage, where the loss is, testing along the line thus with two insulated wires, the ends of which are attached one to the north pole of the voltmeter and one to the south, and the other two ends cleared of the insulation and slightly sharpened. We touch the two poles of each cell, and find after several tests that one cell in the series shows a very low voltage; here must be the trouble, and after closer examination we find a contact between the plates in the battery which actually short-circuits it, and merely allows the current to pass through to the next cell, the same as if the two poles were fastened to a wire reaching across to the next cell. We must take this cell out, and as it is behind the others in the charge, must wait until they are all discharged. Then, after separating the plates, begin anew with the others. If we do not take this precaution, we shall find this cell unequally charged, and thus a drop in our E.M.F. before the battery has done its estimated work. However, when a battery is well formed and equally charged and discharged for a few days, this seldom happens until the batteries have been in use several months. But it does happen with nearly all the styles of batteries now made, and it is impossible to tell when it will take place, especially if the work the battery is forced to do demands at times a discharge in ampère current much over normal, that is 70 or 80 ampères, the tendency being to bend and twist the plates, and thus bring those of opposite poles together so that they touch. This uncertainty is what throws a shade of hazard over the calculations of those using such storage batteries, and is one of the strong objections to placing them in work demanding certainty of performance. Every effort is now being made to make batteries in such a way as to avoid this, but the writer is strongly of the opinion (and practice for one year bears him out in this) that it cannot be done unless the plates are prevented from touching each other, under any strain of work, by some fibrous absorbent that will not disintegrate in the acid nor increase the internal resistance. This the writer has accomplished, so that short-circuiting, that is buckling, cannot take place.

In order to gain this advantage the writer departs from the general mechanical method of building the batteries. Heretofore the plates in all batteries have been placed in an upright position in the cell, face to face and depending entirely upon their own atomic tenacity to hold together. Strips of hard rubber or small buttons of the same material are placed between the plates to prevent their touching each other. This method of separation often fails, especially when a heavy current tends to buckle the plates. There is also a constant tendency in the active material to flake off, or even to fall out and be held between the plates, thus short-circuiting the battery; also a danger from trees of lead, or specular crystals of lead, which form between the plates, and produce the same deleterious action, and which can not be prevented or guarded against. These crystals are very fine, almost needle-like and imperceptible. Another trouble shows itself when the plates are most active. The positive ones become very porous and spongy, and then they fall apart and disintegrate, and the cell is ruined.

The method of building batteries, mentioned above as being an exception to the rule, is this: The plates are placed one over the other, horizontally in the cell, the positive all held together by strong lead lugs, which are cast on each plate. These lugs are hollow and tapered, and are pressed into each other firmly. The negatives are treated in the same manner. Through this continued lug a heavy copper wire is run, and molten lead poured down the lug and around the copper, thus making a firm contact, both chemically and mechanically. Then the two sets of electrodes are slid together, and a peculiar kind of cellulose fibre is placed in thin sheets between the electrodes. This fibre absorbs freely, is a non-conductor, and is of so small resistance to the passage of current or the gases formed in decomposing the water, that it cannot be detected, either in practice or by test. The fibre is of great durability in the acid, and is just close enough in its mesh to prevent any minute material from passing or washing through from one electrode to the other. Thus the plates being supported, and feeling no strains that might tend to disintegration, last much longer than other forms of battery, and when, in the course of two or three years, the positive plates may need renewing, the old ones can be drawn out, and an entire new set slid in.

It is found that the copper wire, imbedded in the lug, carries a larger amount freely, and a discharge of 80, 100 and 125 ampères does not disturb the plates.

STANDARD SPECIFICATIONS FOR ELECTRICAL PLANTS.

THE new catalogue issued by the United Edison Manufacturing Company of America, besides containing an excellent description of the Edison apparatus, embodies a form of standard specifications for electric light plants. These specifications, which we print below, are the result of a large experience in this class of work, and give a very good idea of the manner in which installing is carried out in the States.

Dynamos.—The dynamo must be of such type and must be so connected as to operate with the highest economy, either separately or in multiple arc (in case there be more than one dynamo), and so that in such case the load may be shifted from one machine to another up to the limit of its full load without in any way affecting the candle power of the lamps. The dynamo must be capable of being operated for 10 hours continuously under conditions of full rated load without injurious heating of any part of the dynamo and without sparking. The dynamo must be of such design that the increase in power required to operate it from least load to full load shall be proportional to the number of lamps in operation. The dynamos must have a commercial efficiency under full load of not less than 85 per cent. in dynamo, requiring three (3) horse power in belt, and of not less than 92 per cent. in dynamo, requiring one hundred (100) horse-power; and dynamos of intermediate size shall have an efficiency proportional to the the efficiencies quoted. The commercial efficiency of the dynamo under conditions of one-quarter load shall not vary more than 8 per cent. from that at full load. Each dynamo must be provided with a belt-tightener, so that the tension of the belt may be altered at will while machine is in operation. The armature of the dynamo shall be perfectly balanced, so as to run at its rated speed without appreciable jar. There shall be at least two brushes on each side of the commutator. The insulation resistance between the armature and field coils and the base of the machine must be at least 200,000 ohms. Each dynamo must be placed on a solid wooden base, and must be thoroughly insulated electrically. (When operated continuously for 10 hours under conditions of full load, the temperature of no insulated wire or other electrical portion of the dynamo shall rise in temperature more than 80° C. above the temperature of the surrounding air.) All dynamos shall be provided with self-oiling bearings, which, under normal conditions, shall not require attention, except when the dynamo is started.

Instruments.—Each dynamo must be provided with an ampèremeter in circuit with it, which shall show continuously the current said dynamo is producing. These ampèremeters must be constant, unaffected by any normal change in temperature, and unaffected in their readings by being placed at a distance of 6 feet or more from the dynamo. The ampèremeters must be accurate within 3 per cent.

A pressure indicator shall be furnished for each dynamo or set of dynamos operating in multiple arc. This pressure indicator must be connected so as to indicate directly and continuously the electrical pressure at the point to which it is connected. It must be constant in its readings, unaffected by normal changes of temperature, unaffected in its readings by magnetic influences at a distance of 10 feet from a dynamo, and must be so constructed that a variation of one volt will cause a deflection of the pointer upon the scale readily noticeable at a distance of 10 feet from the indicator.

A ground detector shall be provided which will indicate continuously the condition of each pole of the system as regards insulation to ground.

Incandescent Lamps. — Lamps furnished must be guaranteed to have an average life of six hundred (600) hours, and a corresponding economy of fifteen (15) lamps to the electrical horse-power. All lamps shall be of such uniformity when new that when operated at the voltage for which they are intended, both the power required and the candle-power of the lamp shall be within ten (10) per cent. of the rating. All lamps which give out from any fault within the first ten hours of the operation of the plant, shall be replaced by others without charge. All breakage of lamps beyond this, under normal operation of the plant, shall be considered under the guarantee as to average life. Lamps shall be furnished varying in candle-power from sixteen (16) to one hundred (100), there being at least three (3) different candle-powers between sixteen (16) and one hundred (100). Lamps of different candle-power shall require power in proportion to their candle-power.

Pole Line.—The pole line shall be composed of straight, select, shaved poles. All poles must be set perpendicularly, and must be thoroughly guyed, whenever necessary, to insure this result. They must be set one-sixth of their length below the surface of the ground. All poles must measure at least five inches in diameter at top, and where more than one cross-arm is required, they must measure not less than 6 inches in diameter. They must be housed and gained (*sic*). All cross-arms shall be thoroughly seasoned and free from knots, and painted. All cross-arms must be secured to poles in substantial manner, so that they shall be at right angles with line of pole and parallel with each other, and accurately fitted into gains. All poles where cut-outs are placed shall be stepped. The poles shall not, under any circumstances, be set further apart than one hundred and fifty (150) feet, and in heavy line work they shall not be set more than one hundred (100) feet apart.

Overhead Conductors. — The overhead conductors shall be of bare copper in systems using less than five hundred (500) volts. The pressure lines and service lines shall be insulated by weatherproof insulation. Whenever the conductors are likely to make contact with other materials than the insulators or poles (except leaves) the conductors shall be properly insulated therefrom. No overhead wire having a span of over ten feet shall be run in closer proximity to any other wire than ten (10) inches. All joints shall be made in substantial manner, so that no movement of the two ends relative to each other is possible, and so that the joint is as strong as the wire itself and makes thorough contact. All joints must be soldered. All overhead conductors exposed to influence of atmospheric electricity shall be protected therefrom by suitable lightning arresters.

In all cases where other wires are run above the conductors under consideration, a guard wire must be run to protect the latter from contact with the former.

Wiring and Wiring Devices.—For convenience in reference the wiring will be treated under two heads, the supply wires and the distributing wires.

No distributing circuit shall carry more than five (5) ampères. The distributing circuit shall lead from the distributing cut-outs, which shall be grouped together in cut-out cabinets at various distributing points in the building. Any doors, locks, hinges, &c., if desired for these distributing cut-outs, shall not be furnished by this contractor, but the cut-out cabinet shall be prepared ready for them by the contractor. The maximum loss in any distributing circuit not to exceed two (2) per cent. The cut-outs at each distributing point to be supplied by mains, which mains shall be so proportioned that under any conditions of normal load there shall not be a variation of pressure throughout the mains to exceed two (2) per cent. The connection to the distributing cut-outs from the mains shall be made through double pole fusible cut-outs of proper dimensions. In case current be supplied to the mains through feeders, there shall be fusible cut-outs placed at the points where the feeders join the mains, such cut-outs being placed both at the terminal of the feeder and upon the main immediately on both sides of the feeding point. All lines leaving the dynamo room shall be protected by fusible cut-outs, and in addition thereto any wire leaving dynamo room and carrying a current of more than five (5) ampères shall have a switch in circuit with it. In all moulded or concealed wiring where insulation of the wire makes contact with material other than special insulating material designed for the purpose, a wire of following makes, or equally as good grade and acceptable to the purchaser, shall be used: Edison Machine Works, Grade 3, Habirshaw, Okonite, Grimshaw, Kerite, Clark Safety Insulator. In the case of cleated work, where the wire will never, under normal conditions, be exposed to any moisture, an insulation of the quality known as weather-proof can be used, such as the following or their equivalent: Edison Machine Works, Grade 1, P. & B., K. K., Roeblings's Weather-proof, Ansonia Brass and Copper Co.'s Weather-proof. In all work in connection with the wiring, the wire must invariably be handled so that if the wire were bare the insulation would be the highest possible under the conditions. In other words, the insulation must not be relied upon any more than is absolutely necessary. No wire smaller than No. 18, Birmingham Wire Gauge, or No. 16, Brown and Sharp's Gauge, shall be used. In all cases the ampère capacity of the conducting wires must be carefully determined, and the size of the wires so proportioned that the maximum current carried by them under normal conditions shall not occasion a rise in temperature exceeding sixty (60) degrees Fahrenheit. The wiring must be done in such a manner that in case a different system be used from that originally contemplated, there will be the least possible expense involved in changing the wiring to adapt it to any other system. All joints must be made in substantial manner, so that no movement of the two ends relative to each other is possible, and so that the cross-section of contact is at least twice the cross-section of the conductor. All joints, except when surfaces are held in contact by strong pressure, such as by screws, shall be well soldered and well taped. In all cases where the wire is concealed from view the joints shall be thoroughly covered with some first-class waterproof compound before being taped. All wires that pass through floors or that rest against any metal work shall be protected by a tubing of hard rubber extending at least one inch in each direction beyond such floor or metal work. With all safety devices open, the insulation of any single section of the wiring shall not be less than 100,000 ohms. The combined insulation resistance, when all sections are connected up for service, shall be the highest obtainable when each section measures 100,0000 ohms. Metallic staples for fastening wires shall not be used unless there be placed between the insulation of the wire and the staple some insulating and non-combustible material. Electric light fixtures or gas fixtures carrying electric light wires, if attached to gas pipes, must be insulated therefrom by insulating joint or other suitable means, so that there shall be a high electrical resistance between such electrical light wiring, such fixtures and the system of gas pipes. The wiring must be so proportioned that the maximum variation of electrical pressure at the lamps in different parts of the building under any normal conditions shall not exceed two (2) per cent. All wiring must be neat in its mechanical appearance and arrangement. All points in regard to wiring not above specified shall conform strictly to the requirements of the National Board of Fire Underwriters. All cut-outs shall be made of insulating and non-combustible material, such as porcelain, glass, &c., and shall be double-poled. All switches shall be mounted upon insulating and non-combustible bases, and if covered, shall be so designed that the switch is merely set by hand ready for the break in contact, and the actual breaking of contact shall be done automatically and beyond hand control. The act of making and breaking contact in all switches shall cause the surfaces in contact to be subjected to sliding friction in order to keep such surfaces of contact clean. All sockets shall be of same dimensions relative to the base of the lamp, so that any standard Edison lamp of any candle-power will fit any socket. The socket shall be of substantial, workmanlike construction, and all portions of the shell and key shall be thoroughly insulated.

DIRECTORS' LIABILITY.

LEST our readers should imagine that we have inspired Public Bill No. 300,* at this present moment worrying itself through its stages in the Imperial Parliament, we hasten to disclaim the honour. "A Bill (as amended by the Standing Committee on Trade) to amend the law relating to the liability of directors and others, for statements in prospectuses and other documents soliciting applications for shares or debentures," is prepared and brought in by Mr. Warmington, Mr. David Thomas and Mr. Neville, who deserve the thanks of all investors for raising the question. Its advent is not too early in the day of joint stock association, and no one can accuse it of not being sufficiently drastic or unnecessarily long. It contains four clauses :—The first, the title ; the second, intimating that it is to be construed with the other Companies Acts ; and the fourth, as amended, that it shall come into operation on the first day of October, 1890. Until that date directors have a close time, and may be expected to evolve prolifically. One clause only, clause 3, forms the body of the Bill ; but this one is sufficient to make directors *in posse* "sit up."

> Where a prospectus or notice invites persons to subscribe for shares in or debentures or debenture stock of a company, every person who is a director of the company at the time of the issue of the prospectus or notice, and every person who is named in the prospectus or notice as a director of the company or as having agreed to become a director of the company either immediately or after an interval of time, and every person who has authorised or is responsible for the issue of the prospectus or notice, shall be liable to pay compensation to all persons who shall subscribe for any shares, debentures, or debenture stock for the loss or damage they may have sustained by reason of any inaccurate or misleading statement in the prospectus or notice, or in any report or memorandum incorporated therewith or referred to therein, unless he proves—
>
> (*a.*) With respect to every such inaccurate or misleading statement of fact not purporting to be made on the authority of an expert, that he made reasonable inquiry and examination into the statement and had reasonable ground to believe, and did then and up to the time of the allotment of the shares, debentures, or debenture stock, as the case may be, believe that the statement was true ; and
>
> (*b.*) With respect to every statement or extract purporting to be a statement of, or an extract from, any report or valuation of any engineer, valuer, accountant, or other expert, that it was a true and fair statement of, or extract from the report or valuation, and that the report or valuation was made by the person whose name it bears, and that he had reasonable ground for believing, and did then and up to the time of the allotment of the shares, debentures, or debenture stock, as the case may be, believe, that the report or valuation was made in good faith, and that the person making it was competent to make it ; or unless he proves that he had not consented to be become a director of the company, or that having so consented, he withdrew his consent before the issue of the prospectus or notice, and that the prospectus or notice was issued without his authority or consent.

It is possible that the gentlemen who back the Bill are not intending to set up in the directorial line, for that line, if the Bill were to become an Act as it stands, would not fall in pleasant places. However wisely we may have loved the director, it has not been our lot to love him too well ; but in his hour of trial we beg to extend him our sympathy. We read in the daily press that Mr. Warmington has been warmly congratulated on his Bill. Possibly, but by whom ? Not by directors surely, nor by anybody who has seriously considered the question with a full knowledge of the subject. We are inclined to agree with Sir Roper Lethbridge who, in moving an amendment, remarked that the whole Bill is in a chaotic condition. Supposing it to have become law as drafted, no sensible man would be a director, nor would any respectable office boy's mamma allow her son, on leaving the Board school, to serve the Board room, for "others," defined as "every person who is responsible for the issue of the prospectus," would seem to include the secretary, solicitors, bankers, auditors, clerks, boy, porter, and possibly the printer and postman. We have heard of men who, sighing for some one willing to incur the expense of making them bankrupts, sighed in vain. To this class we should have to look for directors—to those who have nothing to lose ; and the last state of the shareholders would be worse than the first. The most common sin of directors is ignorance of the business they have to direct ; but this very ignorance is to some extent often a necessity and pleadable as an extenuating circumstance ; relying on "experts," they have not all the knowledge to enable them to judge who is an expert and who is not. As amended, the word "expert" is to include any person whose official or professional knowledge gives authority to a statement made by him. Another amendment is, that a director is to be exempted from liability where he has reasonable grounds for believing a report or valuation was made by the person whose name it bore, after reasonable enquiry and examination.

It would not be well for companies that men of means should be afraid to accept seats on boards. There are plenty of company directors in both Houses, so let us hope a workable measure will be finally turned out at which all honest men may rejoice.

Promoters of traction companies please note.

THE PAISTE SWITCH.

WE illustrate in our columns to-day a novel switch designed and patented by Mr. H. T. Paiste, of Philadelphia, Penn., U.S.A. This switch has met with deserved success in America, where over 100,000 are in daily use, and judging from a number of letters which Mr. Paiste was good enough to show us, it has evidently been adopted by all the leading electric companies of that country.

Mr. A. Reyrolle, of London, has secured the European rights to manufacture and sell this switch, and has furnished us with the following description :—

It was the object of the inventor to abandon the use of spring metal for electrical contact, as practice had demonstrated that metal soon lost its elasticity when under the action of electric currents, and with this in view he used two plates (made from sheet brass), one U-shaped, the other being straight. These are shown in the accompanying cut, mounted on a base of non-conducting material. The binding screw on U-shaped plate is the terminal of one circuit wire, and the screw on straight plate the terminal of the other. Two arms,

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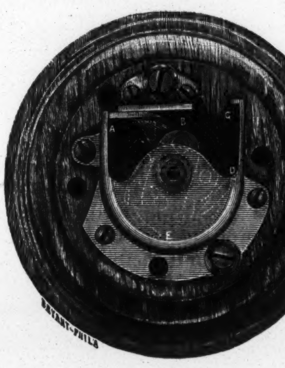
* This Bill has passed for third reading.

A and D, are hinged to a spindle, the bearing of which is located in the centre of U-shaped plate. A spring joins the end of the two arms, which keeps the arm, A, pressing firmly against the straight plate, also the arm, D, against the U-shaped plate. As shown in the cut, the circuit is completed as the arm, A, joins the U-shaped plate and the straight plate, through its spindle and the arm, D, also at its point. To break circuit, the spindle is turned (by means of a handle screwed into its centre) to the right a quarter turn; by so doing the arm, A, slides along the straight plate (cleaning it) until the position, B, is reached (while the arm, A, slides along the straight plate it is lengthening the spring), at which point the straight plate becomes the tangent of a circle, of which the arm, A (hinged on the spindle), becomes the radius. As soon as the straight plate becomes the tangent, the arm, A, flies rapidly to position shown at C, when the circuit is broken. Whatever arcing there is is on back of arm and not on face where electrical contact is made. The circuit is completed by a like movement, the arm, D, coming to rest in position shown by A. Each time the switch is used better contact is secured, as the arm seats itself in the straight plate, like a hammer blow. This switch, in various sizes, is now being mounted on china, with cover and handle of same material, making a small, neat and artistic fixture.



The Electric Supply Company, of Chicago, state that they have sold several thousands of Mr. Paiste's snap switch, and never had one returned nor a single complaint. A letter from the Sawyer-Man Electric Company, New York, says that they have sold thousands of the 10 ampère single-pole switch, no complaints having reached them from any quarter; one from the Central Thomson-Houston Company, Cincinnati, is as follows:—"Having used several thousands of your switches, it gives us pleasure to be able to give them our hearty endorsement, and you are at liberty to refer to us at any time." The New England Electric Supply Company, Bridgeport, writes:—"We take much pleasure in saying that in our opinion the Paiste switch is incomparable. Of the thousands that we have sold, not one has been damaged either by burning or owing to mechanical defect. The economy in using the switch is obvious, while certainty of its action is of the utmost value." Central Electric Company, Chicago, say:—"We have handled many thousands of the Paiste switch, and we know of no complaints; on the contrary, our customers speak of it in terms of praise." Mr. Paiste showed us dozens of other testimonials to a similar effect.

Storms and Electric Wires.—It has for some years been the practice at the Berlin Post Office for the *employés* to make a note of storms and magnetic disturbances, direction of storms, length, &c., and the result has demonstrated that underground wires, without being entirely free from the influence of magnetic storms, are much less liable to disturbance than overhead ones; and, on the other hand, that accidents from lightning are much less serious in those towns where the overhead system is in vogue.

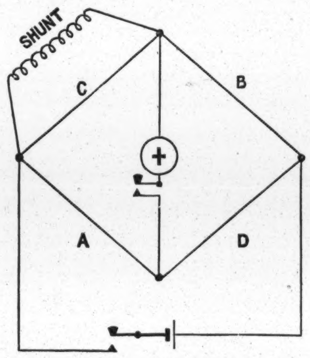
ACCURATE MEASUREMENT OF LOW RESISTANCES.

EVERYONE who has had occasion to use the Wheatstone bridge, with the mirror galvanometer, for the purpose of measuring small resistances has suffered from the inconvenience and difficulty consequent on inexact balance, even when unequal arms are used.

Recently finding it necessary to obtain a very accurate adjustment with the bridge, with arms of equal resistance and not exceeding 100 ohms each, the minute differences of resistance existing between the arms, although nominally equal, rendered an accurate balance impossible.

The use of fine wires, sliding contacts and various other devices were tried, without any satisfactory result.

It then occurred to me to shunt one of the higher resistance arms with an adjustable resistance very much greater that itself, and this was found to be perfectly successful; alterations of the shunt, enabling a perfect balance to be obtained, although the conditions were such that a difference of $\frac{1}{1000000}$th in the joint resistance of the shunted arm produced a deflection of one division.



This mode of attaining the condition of perfect balance has no doubt suggested itself to others, but does not appear to have been published before and it may be of service to draw attention to it now.

It is clear that it is not only useful in attaining a perfect balance with some predetermined fixed resistance, but may be employed in the exact determination of small fractions of an ohm which are now less accurately estimated by using arms of unequal resistance.

If determinations to $\frac{1}{1000}$, $\frac{1}{10000}$ or $\frac{1}{100000}$ are required, the shunt should be respectively 1,000, 10,000, or 100,000 times the arm resistance, and it may be used to determine a resistance which by that amount is in excess of, or is less than, the resistance unplugged in the measuring arm.

For *plus* results in D the shunt should be placed across the arm A, and for *minus* results across the arm C; and it will be found in practice that this method admits of very exact measurements with great ease of manipulation.

A. EDEN.

SHAPING FILAMENTS OF INCANDESCENT LAMPS.*

WHEN the loop-shaped filaments of incandescent lamps are straightened by a weight during the period in which the air in the bulb is exhausted, the removal of the weight is found to be a rather delicate operation. In straightening the filaments in this manner it has ordinarily been found necessary to attach to each lamp bulb an exhaust tube longer than usual. After the operation of exhausting has been completed, this tube is first sealed some distance from the globe, and the lamp removed from the pump. By manipulating the lamp the weight is unhooked from the loop and dropped into the tube, which is then sealed off from the lamp. The accompanying diagram illustrates an improved method of handling the weight by magnetism. A glance at figs. 1 and 2 will show the simplicity of the operation. The small weight shown in the tube and hung on the filament is made of iron or other magnetic material. By this construction it is only necessary to use a magnet, as shown in fig. 1, or a solenoid, as indicated in fig. 2, and the weight may be manipulated as desired. It is evident, too, that the magnetism of the solenoid or permanent magnet may be employed to increase or diminish the strain or pull on the weight. This insures a delicacy of adjustment otherwise unattainable. This method of weight manipulation in the above-mentioned process is the invention of R. N. Dyer of New York.

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* *Western Electrician.*

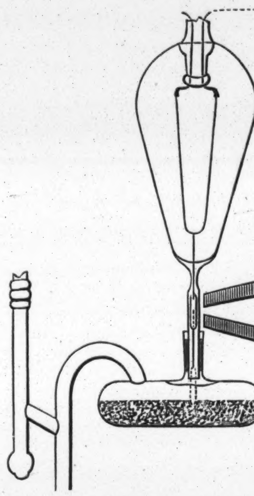


FIG. 1.

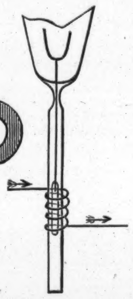


FIG. 2.

NEW MARINE SIGNALLING APPARATUS.

A NEW mechanical apparatus, in which electricity plays a part for night operations, has been invented by Mr. R. J. Crowley, for marine signalling purposes. The apparatus may be fixed to any top-mast, and consists of a hollow iron mast, from the right and left-hand sides of which project horizontally four oblong metal frames. Each of these contains two shutters, which in their normal position are horizontal, and which are mounted on axes so that they may be revolved. One side of each pair of shutters is painted vertically with red and white stripes, whilst the other side forms a white diamond on a dark ground. At the inner end of each shutter is fixed a recessed pulley over which passes a chain which on being pulled grips the pulley and causes the shutter to revolve. Only four working chains are required, the lower pulley of each frame being operated by a subsidiary chain suspended from its corresponding operating chain. The working chains are carried to the bottom of the iron mast, where they are joined to wire ropes extending to the deck of the vessel, or any other desired part thereof. The shutters represent the alphabet, and also certain signals. Thus on causing any shutter, or combination of shutters, to be exposed by pulling any one or more chains, any letter or words may be flashed. The four wire ropes are fastened to horizontal levers, so that by depressing or raising any one lever any message may be signalled. The operator has only in front of him the four levers and a card upon which the code is printed. Signals may be transmitted with this apparatus with great rapidity, and by a mere tyro.

The electrical part of the apparatus comprises four electric lamps fixed at the four corners of the frames, and is only used for night signalling in conjunction with the same code. The four lamps are backed by coloured reflectors, and are connected with a battery or dynamo, as the case may be, through make and break switches. Thus on depressing any switch its corresponding lamp is placed in circuit and lighted, whilst on releasing the switch the light is extinguished. By this means any signal may be flashed. A fifth electric lamp is also fixed on the apparatus, and is used purely for lighting purposes. A company will shortly be formed to work this invention, which is of American origin. Further information will be furnished by Messrs. Salter, Hunt and Co., of 62, King William Street, E.C.

SEEING BY ELECTRICITY.

THE exhibition, at the Jubilee of the Penny Post, held at the South Kensington Museum, of an apparatus called the electrophonoscope, though it no doubt answered the amusing purpose of a penny peep-show, did not advance, it is perhaps needless to say, the problem of seeing by electricity a single stage. The apparatus was, we believe, nothing more than a well-arranged combination of a telephone and the well-known optical delusion which enables the intelligent rustics at the country fairs to "see through a four-inch deal board," or through one of their companions equally hard craniums. In fact, as regards the "seeing" part of the apparatus, there was nothing electrical about it, except the illumination of the reflectors by incandescent lamps. It is now some years since the late Robert Sabine, Profs. Ayrton, Graham Bell, and others suggested that the problem of "seeing by electricity" might be partially solved by the aid of a series of selenium cells, arranged in a mosaic pattern, and upon which an image of the subject to be transmitted was projected; but no practical result seems to have developed from the crude idea. Edison, we hear, is working away at the question, but whether he has arrived at an approximation to a solution anything more definite than mere rumour does not indicate. An announcement that success had been attained would of course be heralded in the daily press by the usual stereotyped announcement of a "revolution in telegraphy, the far-reaching consequences of which it is impossible to estimate," words which, as regards the latter part of the statement are, no doubt, strictly true, as the almost invariable falsification of the prediction shows the inability of the "dailies" to estimate correctly the value of scientific discoveries. One great direct practical value of a really successful method of electrical vision would be great rapidity of telegraphic transmission, as—unlike the telegraph and the telephone, where the communication of intelligence is the result of a sequence of expressions one following after the other, and which, consequently, takes up time—seeing by electricity means the simultaneous transmission of the facsimile of all parts of a picture or object, which would be visible to an almost unlimited number of spectators; consequently, a long written or printed message, if made visible, could have its several paragraphs copied down each by a different person, and all writing at the same time.

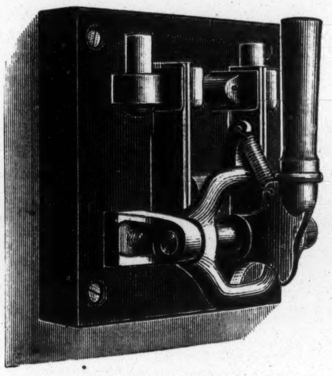
The Post-Office Jubilee.—The celebration reception and exhibition on Wednesday night, under the Presidency of the Duke of Edinburgh, seems to have been entirely successful. The feature which excited the greatest interest was the electrophonoscope show, a little delusion which reflected great credit upon its learned originators, and which caused many persons to go away under the impression that seeing by electricity has become an accomplished fact.

NOTES.

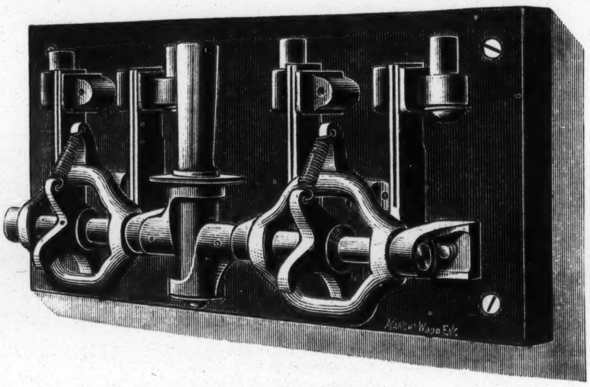
Electrical Measuring Apparatus.—In the report on the Weymersch battery, which we published last week, the names of Messrs. Sharp & Kent were inadvertently omitted from the list of those firms who so obligingly lent the testing instruments.

Automatic Electrical Call Boxes.—We understand that a similar call box to the one referred to in our issue of the 13th ult. has been patented in Germany, and that it is already in use in Breslau, Hamburg, and Berlin. It is very probable that one of this make will be shown in London in two or three months hence.

Main Switches.—Yet another series of switches, this time of the main or switchboard type, is about to be introduced by Messrs. Dorman and Smith, of Manchester and London. There is nothing strikingly novel about these switches, their principal characteristic being their extreme solidity. The illustrations show these arranged for use both for "single" and "double" pole. They are at present made in four sizes in both types, are of gun-metal, with steel shafts, and are mounted on slate slabs. They have a double break, good spring contacts, and instantaneous release, and being fitted with conical thimble terminals, arranged either on the front or back, are easy to couple up.



SINGLE POLE SWITCH.



DOUBLE POLE SWITCH.

Telephone Call Boxes.—We are informed that in a few months telephone call boxes will be installed in various London districts, so that persons desiring to communicate with the exchange and then to subscribers may do so. The money to be paid for conversation will be deposited in slots, when the exchange may be rung up. Subscribers will, however, each be provided with a key which will fit into holes in the boxes, and by means of contacts inform the exchange attendant that the person desiring to communicate is a subscriber. Of course, the latter will not have to pay any fee other than his annual subscription.

Death of the Swiss Director of Telegraphs.—The death is announced of Herr Frey, Director of the Swiss International Telegraph Bureau, who was only recently appointed.

Prize.—The Société d'Encouragement pour l'Industrie Nationale has awarded to M. Gramme the Ampère medal.

Messenger Call System.—To advocate the claims of this system a conversazione will take place at the Royal Institute of Painters in Water Colours on July 12th.

An Error.—Messrs. Crompton & Co. correct our statement made last week as to the price per unit at Chelmsford. It should be 1s., not 1s. 3d.

The Tory Island Cable.—The steamer *Buccaneer* left Silvertown on Wednesday to lay the cable connecting Lloyd's signal and telegraph station on Tory Island with the mainland.

Corporation of Salford v. Lever.—The judgment given against Mr. Lever at Leeds last month was upheld in the Queen's Bench Division on Saturday. It was intimated that there would be an appeal.

Arc Light and Battery Carbons.—A point brought out in the discussion upon Mr. Marks's paper on "Arc Light Carbons" at the recent meeting of the American Institute of Electrical Engineers, had reference to the control of the arc by means of a small energised coil in suitable proximity to it. According to Mr. Marks, it is possible in this way to maintain a perfectly steady, noiseless arc, and Prof. Thomson's experience supported this view. An American contemporary, however, thinks it doubtful, if the method possesses the requisite simplicity for commercial purposes. Our contemporary thinks also that the suggestion made by Mr. Pope at the same meeting, that some competent student should take up the study of battery carbons, should be acted upon, as it would result in the discovery of many valuable principles, and in the confirmation of many of the now accepted theories in connection with the battery carbon.

Technical Education.—At the Department of Science and Art of the Committee of Council on Education, South Kensington, a letter from Mr. J. W. Pye-Smith, Town Clerk of Sheffield, dated 16th May, 1890, was read, stating that the Town Council of that borough propose to make grants, under the powers conferred upon them by the Technical Instruction Act, 1889, to certain institutions in Sheffield for the promotion of technical instruction; that at one of these institutions instruction is given in the following subjects, which are not included in the branches of science and art, with respect to which grants are at present made by the Department of Science and Art, viz.:—1. Manual training or instruction in the use of tools for working in wood and iron; 2. Plumbers' work; 3. Electro-metallurgy; 4. French; 5. German; 6. Type-writing; 7. Shorthand; and that, in the opinion of the Town Council, such a form of instruction is required by the circumstances of its district. In accordance with the request of the Town Council, the Lords of the Committee of Her Majesty's Most Honourable Privy Council of Education have been pleased to sanction this form of instruction under clause 8 of the Technical Instruction Act, 1889, for the borough of Sheffield, and this minute will be laid before Parliament in accordance therewith.

New Business.—Messrs. Pollock and Macnab, of the Britannia Iron and Engine Works, Hyde, near Manchester, announce that they have opened a new department in their business, that of electrical engineering. They have engaged as practical superintendent a specialist of large experience in some of the largest electrical engineering establishments in the Kingdom, and are therefore in a position to make electrical machinery and plant for electric lighting. They solicit a visit to see the plant they have put down for themselves.

Electric Lighting Orders.—Mr. O. V. Morgan asked the President of the Board of Trade whether the effect of the provisions which the Board had inserted in electric lighting orders now before Parliament, authorising local authorities to transfer their undertakings, would be practically to confer upon the Board of Trade powers to perform functions heretofore exercised by Parliament, and also deprive the public of the means that they now had of resisting any such transfer by appearing before a Parliamentary Committee where evidence was taken upon oath; and whether the Board would have the power to administer an oath if the functions of Parliament were so vested in that department. Sir M. Hicks-Beach: Section 11 of the Electric Lighting Act, 1882, provides that "no local authority, company, or person shall by any contract or assignment transfer to any other company or person or divest themselves of any legal powers given to them, or any legal liabilities imposed on them by this Act, or by any license, order, or special Act, without the consent of the Board of Trade." The provisional orders granted under the Act referred to require that public notice of the proposed transfer shall be given, and the transfer cannot be made without the consent of the Board of Trade, by whom the deed of transfer must be approved, and who will make any enquiries that they may consider necessary in the interests of the public. The Board of Trade would have no power to administer an oath. With regard to the merits of the clause, I wish to point out that the local authorities, who are representatives of the ratepayers, ought to be the best judges of their interests in matters affecting the lighting of the town.

The Halifax and Bermuda Cable.—A cablegram has been received by the Halifax and Bermuda Cable Company from the ss. *Westmeath*, in lat. 35° 11 min., long. 64° 7 min., stating that at noon on the 29th inst. 623 knots of the cable had been paid out, and that the steamer was now well past the influence of the Gulf Stream. Weather fine and everything satisfactory. The cable was completed on Tuesday last, and Messrs. W. T. Henley's Telegraph Works Company, Limited, are to be congratulated on the success they have met with in laying the new cable. A large number of soundings were taken, the bottom being found even and quite satisfactory; the greatest depth ascertained was 2,820 fathoms. The paying out of the cable was commenced on Wednesday, the 25th ult., and the ship arrived off Bermuda at noon on the 30th.

New Companies.—We understand that no less than 100 new companies have been registered during the past week. As may be seen in our columns a goodly proportion are electrical.

A Financial Paper's Views.—The *Financial Times*, speaking of the Okonite scheme, says:—"Before English capitalists rally round a concern intended to combine an American with an English business, they will want something a little more satisfying than a report by one of the English vendors on the American property, and by the American vendor on the English property, and those furnished by Mr. F. L. Rawson and Mr. F. Cazenove Jones respectively are the sole grounds on which the International Okonite Company bases its appeal to the public."

More Newspaper Science.—In the evening edition of yesterday's *Standard* it is gravely asserted that the power of the electrophonoscope to reproduce images is due to the employment of selenium, "whose capacity to transmit sunlight pictures has long been known to scientific men." If it is not too expensive, says our daily contemporary, we shall ere long find it in every office where a telephone is employed. We thought that the *D. T.* and another were the only papers which Messrs. Hughes, Preece and Stroh had fooled, but it is painfully evident that the "Technical and General News Agency," to which we referred last week, is more than ever a necessity of the *Times*.

Manufacture of Double Carbon Lamps.—The Brush Company, of Cleveland, has obtained an injunction against the Sperry Electric Company covering the manufacture or use of double carbon lamps. This is the fourth decree obtained by the Brush Company on this patent.

Okonite.—In 1886 a Mr. Smith, who was exhibiting in London the manufacture of okonite, gave a piece of the material to an electrical firm, who submitted it to a well-known analyst, whose report was as follows:—

Rubber	49·60	per cent.
Sulphur	5·30	„
Lamp Black	3·20	„
Zinc Oxide	15·50	„
Litharge	26·30	„
Silica	0·10	„
	100·00	

Personal.—Mr. Charles F. Quicke, works manager of the establishment of Messrs. Immisch, electrical engineers, of Kentish Town, was installed Worshipful Master of the Chislehurst Lodge of Freemasons, No. 1,531, at Chislehurst, on Saturday last, in the presence of a large number of metropolitan brethren.

The Electrophonoscope.—"This remarkable instrument will be exhibited for the first time at the Post Office Jubilee *soirée* at the South Kensington Museum. It is the joint invention of Prof. Hughes, F.R.S., Mr. Preece, F.R.S., worked out by Mr. Ströh, and Mr. Roberts, one of the Post Office officials. It solves the question of visual telegraphy. The sender of a message from a distant station appears in person before his correspondent, and with a telephone it is possible not only to speak to him, but to see him, and to watch the expression of his features. It is a perfect complement to the telephone, and will illustrate what telegraphy is likely to be in 1990." The above is the official description of the apparatus, which we have dealt with—we hope as it deserves—on another page.

Electric Lighting in St. Pancras.—Prof. Robinson has extended the time for receiving tenders for the various contracts. At a recent meeting of the vestry a letter was read which stated that the County Council had decided to advance the vestry a loan of £10,000.

The Institution of Electrical Engineers.—The Secretary sends us the following communication:—Referring to the circular in regard to the Edinburgh meeting, issued by me to members of the Institution on the 25th ult., to which you were good enough to draw attention in your columns, I shall feel greatly obliged by your mentioning in your next issue that both the London and North-Western and the Midland Railway Companies have consented to issue to any of our members who may be proceeding to the meeting return tickets of any class, available for eight days, at the same reduced price as has been agreed to by the Great Northern Railway Company, viz., at a single fare and a quarter. The tickets will be issued from any of the stations of these companies' lines on production of a note signed by me, respecting which I shall in a few days issue to all who may have intimated their intention to attend the meeting, and who already number over one hundred, a circular, accompanied by a programme of the proceedings.

Hammersmith and Fulham Electric Lighting.—At a meeting of the London County Council on Tuesday last, the Parliamentary Committee reported that the Board of Trade had intimated to the Parliamentary agents that this order would not be proceeded with.

Electrical Plant.—Mr. Lea's successor, as editor of this monthly trade journal, is Mr. E. R. Dolby, A.M.I.C.E.; this gentleman has, on various occasions, contributed technical descriptions of electrical apparatus to the columns of the Review, and we wish him prosperity.

Admiral Colomb to be Rewarded.—Lord G. Hamilton stated in the House of Commons on Tuesday, that the Government had decided to offer Admiral Colomb a further sum of £2,000 for his services in connection with the flashing signals used in the Navy.

A Slight Drop.—In the Fowler-Waring mains, on which the Deptford central station at present depends, the loss, with the load now in use, amounts to 1,200 volts.

The Brighton Electric Light Wire Accident.—On the appeal of the Brighton Electric Light Company against the damages awarded to Mrs. Garman for the death of her husband, the damages were reduced to £500.

Cable Manufacture in Italy.—Messrs. Pirelli & Co., whose works last year were almost at a standstill, are negotiating with the Italian Government for another cable which it is proposed to lay in Italian waters.

The Electric Light in Preston.—Provisional orders were issued on Wednesday morning authorising the National Electric Supply Company and the Lancashire and Cheshire House-to-House Electricity Company to supply various parts of the borough of Preston with electricity. These orders have yet to receive the sanction of Parliament.

Personal.—Mr. A. E. Mavor, M.I.E.E., at present electrical engineer to Messrs. Denny & Brothers, Dumbarton, has been appointed general manager of the Fowler-Waring Cables Company, Limited, of 85, Queen Street, Cheapside.

Telpherage at Edinburgh.—The telpher line at the Edinburgh Exhibition was opened last week on the occasion of the visit of the Lord Mayor of London. It has been made by the Electric Construction Corporation, who are, we understand, engaged upon a telpher line through the Via Flaminia, Rome, which is expected to be opened very shortly.

Elmore's Patent Copper Depositing Company.—This company has now on exhibition, at 56, Queen Victoria Street, an interesting collection of specimens of seamless copper tubes, seamless copper cylinders, high conductivity wire and other products made under the company's patents upon a commercial scale at their works in Leeds. Some tests of copper deposited by this process were recorded in our issue of June 14th, 1889.

Electric Launch Building.—We are informed that the boat building business hitherto carried on at Strand Works, Chiswick, by Mr. Sargeant, the builder of the well known *Viscountess Bury*, has been acquired by Woodhouse and Rawson United, Mr. Sargeant's services being retained as manager of that department of the business.

NEW COMPANIES REGISTERED.

Thetford Electric Light and Power Co., Limited.—Capital £5,000 in £10 shares. Objects: To carry on in all branches the business of an electric light and power company. Signatories (with one share each): *C. Burrell, jun., *R. G. Burrell, *F. J. Burrell, J. Houchen, F. V. Houchen, T. Lumley, all of Thetford, Norfolk; *W. Jackson, Knottingley, York. The signatories denoted by an asterisk are the first directors; qualification £50 in shares or stock. The company in general meeting will determine remuneration. Registered 23rd inst. by Mr. R. Jordan, 120, Chancery Lane. Registered offices, St. Nicholas Street, Thetford, Norfolk.

International Okonite Company, Limited.—Capital, £340,000 in £10 shares. Objects: To manufacture insulated and other wires and cables for telegraphic, telephonic, and other purposes, and for such purposes to adopt an agreement with Woodhouse and Rawson United, Limited. To carry on business as electricians. Signatories (with 1 share each): F. Spooner, 83, Rendlesham Road, Lower Clapton; J. Beaumont, 9, Daneville Road, Camberwell; H. E. Smith, 26, Park Place, Leyton; H. C. Newton, 121, Avenell Road, N.; J. S. Stornden, 60, Moray Road, N.; W. Dauney, 6, Lexham Gardens, W.; A. Stevens, 4, Trafalgar Square. The first English directors will be appointed by the subscribers; remuneration, £1,500 per annum, and in addition 3 per cent. on all net profits other than profits derived from the American branch of the business. There will be a committee of management in America, the first members of which are F. Cazenove Jones, H. Durant Cheever, W. L. Candee, J. H. Cheever, and H. Martin; remuneration, 5 per cent. on all net profits resulting from the American branch of the business. Qualification for subsequent directors, 50 shares or £500 stock. Registered 24th ult. by Parker, Jarrett and Parker, St. Michael's Rectory, Cornhill.

S. Z. de Ferranti, Limited.—Capital, £100,000 in £10 shares. Objects: To purchase any business or patents relating to electricity. Signatories (with 1 share each): *S. Z. de Ferranti, *H. P. Sparks, Charterhouse Square; *F. Ince, J. B. Ince, St. Benet Chambers, Fenchurch Street; T. W. Hunter, 2, Dashwood Road, Stroud Green; A. Wright, 3, Clermont Road, Brighton; H. W. Kolle, Egremont, Tulse Hill. The first three signatories are appointed directors; qualification, 100 shares; the company in general meeting will determine remuneration. Registered 26th ult. by Ingledew, Ince and Colt, St. Benet Chambers, Fenchurch Street.

Woolwich District Electric Light Co., Limited.—Capital £10,000, in £1 shares. Objects: To carry on the business of an electric light company in all branches. Signatories (with 20 shares each): J. T. Randall, A. W. Mellish, Robt. Webb, R. B. Dale, G. H. Campbell, G. Whale, W. H. Pryce, all of Woolwich; J. R. Jolly, J.P., Plumstead. Registered without special articles by G. Whale, 54, Cannon Street.

Canterbury Electricity Supply Company, Limited.—Capital £100, in £1 shares. Objects: To carry on the business of electrical engineers and suppliers of electrical apparatus, mechanical and chemical engineers. Signatories (with 1 share each): Emile Garcke (Manager and Secretary Brush Electrical Engineering Company, Limited); J. L. Raworth (engineer); W. C. Mann, R. A. Dawburn (electrical engineer), W. M. Mordey (electrician), R. Percy Sellon, W. Geipel (electrical engineer), all of 112, Belvedere Road, Lambeth. Most of the regulations of Table A of the Companies' Act, 1862, apply. Registered 28th ult. by Sydney Morse, 4, Fenchurch Avenue, E.C.

Cardiff Electricity Supply Company, Limited.—Capital £100, in £1 shares. Objects: To carry on the business of electricians in all branches. In this and following six companies the signatories are the same as in the preceding company. Registered 28th ult. by Sydney Morse, 4, Fenchurch Avenue.

Henley Electricity Supply Company, Limited.—Capital £100, in £1 shares. Objects: To carry on business as electricians. Registered 28th ult. by Sydney Morse, 4, Fenchurch Avenue.

Ipswich Electricity Supply Company, Limited.—Capital £100, in £1 shares. Objects: To carry on business as electricians. Registered 28th ult. by Sydney Morse, 4, Fenchurch Avenue.

Loughborough Electricity Supply Company, Limited.—Capital £100, in £1 shares. Objects: To carry on business as electricians. Registered 28th ult. by Sydney Morse.

Manchester Electricity Supply Company, Limited.—Capital £100, in £1 shares. Objects: Electricity in all branches. Registered 28th ult. by Sydney Morse.

Penzance Electricity Supply Company, Limited.—Capital £100, in £1 shares. Objects: To carry on business as electricians in all branches. Registered 28th ult. by Sydney Morse.

Weymouth Electricity Supply Company, Limited.—Capital £100, in £1 shares. Objects: Electricity in all branches. Registered 28th ult. by Sydney Morse. The registered offices of the above companies are at 112, Belvedere Road, Lambeth.

Kidderminster Electric Light and Power Supply Company, Limited.—Capital £1,000, in £1 shares. Object: To carry on at Kidderminster or elsewhere the business of an electric light and power company in all branches. Signatories (with 1 share each): C. S. Peach, 8, John Street, Adelphi, architect; E. Bax, Eltham, Kent; C. Roberts, C.E., 6, Gray's Inn Place; J. R. Cleave, Hotel Windsor, Victoria Street, S.W.; E. J. Jennings, 13, Victoria Street, engineer; R. Thicknesse, 11, Abchurch Lane; T. B. D. Cooper, 5, Victoria Street, engineer. The subscribers are to appoint the first directors. Qualification, £50 shares or £50 stock. Remuneration, £200 per annum to the chairman, and £100 per annum to each director. Registered 28th ult. by Fox and Thicknesse, 11, Abchurch Lane.

East Coast Electric Light and Power Company, Limited.—Capital £1,000, in £1 shares. Objects: To carry on in the towns of the East Coast or elsewhere the business of electric lighting. The signatories for one share are the same as in the preceding company, and the same arrangements for directors also appply. Registered 28th ult. by Fox and Thicknesse.

Devonshire Electric Light and Power Company, Limited.—Capital £1,000, in £1 shares. Objects: To carry on in Devonshire or elsewhere the business of electric lighting in all branches. The signatories are the same as in the two preceding companies, and the same regulations as regards directors also apply. Registered 28th ult. by Fox and Thicknesse.

Camberwell and Islington Electric Light and Power Company, Limited.—Capital, £1,000 in £1 shares. Objects: To carry on in the parishes of Camberwell and Islington the business of electric lighting. The signatories of the three preceding companies take one share each in this company. The same regulation for directors also apply. Registered 28th ult. by Fox and Thicknesse.

Stamford Hill, Tottenham and Edmonton Electric Light and Power Company, Limited.—Capital, £1,000 in £1 shares. Objects: To carry on in the neighbourhoods mentioned in title the business of electric lighting. The signatories of the four preceding companies subscribe for one share each in this company, and the same arrangements for directors apply. Registered 28th ult. by Fox and Thicknesse.

Provincial Electric Light and Power Supply Company, Limited.—Capital, £1,000 in £1 shares. Objects: To carry on electric lighting business in the provinces. Signatories as in five preceding companies. Registered 28th ult. by Fox and Thicknesse.

New Cadogan and Belgrave Electric Supply Company, Limited.—Capital £1,000, in £10 shares. Objects: To take over the business and undertaking of the Cadogan Electric Light Company, Limited. Signatories (with 1 share each): *A. Greenwood, 8, Cavendish Road, Leeds; *Lieut.-Col. A. W. Thynne, 50, Cadogan Square; J. S. Sayer (electrical engineer), 37, Drayton Gardens, South Kensington; G. Chapman, 48, Luiver Road, Fulham; G. Hogger, Hether Green, Lewisham; C. Bonsor, 8, Vincent Square, Westminster; A. S. Batley, Thames Ditton. The signatories denoted by an asterisk are the first directors; qualification, £100 in ordinary shares; the company in general meeting will determine remuneration. Registered 30th ult. by Brook, Freeman & Batley, 89 Chancery Lane.

Weston-super-Mare Electricity Supply Company, Limited.—Capital £100, in £1 shares. Objects: To carry on business as electricians and electrical engineers in all branches. Signatories (with 1 share each): H. G. Massingham, Bath Electric Light Works; Emile Garcke, J. C. Raworth, R. A. Dawburn, W. Geipel, W. M. Mordey, and R. Percy Sellon, all of 112, Belvedere Road, Lambeth. Most of the regulations of Table A of the Companies' Act, 1862, will regulate the affairs of the company. Registered 30th ult. by Sydney Morse, 4, Fenchurch Avenue; office, 112, Belvedere Road.

Bristol Electricity Supply Company, Limited.—Capital, £100 in £1 shares. Objects: To carry on business as electricians in all branches. The signatories are the same as in the preceding company. Registered 30th ult. by Sydney Morse, 4, Fenchurch Avenue, E.C.

Northern Counties Electric Light and Power Supply Company, Limited.—Capital, £1,000 in £1 shares. Objects: To carry on in Northumberland and elsewhere the general business of an electric light company in all branches. Signatories (with 1 share each): Ralph Thicknesse, 11, Abchurch Lane; E. J. Jennings, 13, Victoria Street; E. W. Monkhouse, 3, Robertson Terrace, Hastings; F. B. Nicholson, 9, St. Petersburgh Place, Bayswater; F. W. Stenlake, 13, Victoria Street; A. F. Barter, 60, Hercules Buildings, Lambeth; Wm. Jennings, 59, Fleet Street. The signatories are to appoint the first directors; qualification, £50 in shares or stock; remuneration, chairman, £200 per annum; each director, £100 per annum. Registered 30th ult. Solicitors, Messrs. Fox and Thicknesse, 11, Abchurch Lane.

Paddington and Bayswater Electric Light and Power Supply Company, Limited.—Capital, £1,000 in £1 shares. Objects: To carry on electric lighting in the parish of Paddington and elsewhere. Signatories (with 1 share each): F. B. Nicholson, 7, St. Petersburgh Place, Bayswater; C. Jennings, Montpelier Road, S.E.; E. J. Jennings and F. A. Stenlake, 13, Victoria Street; C. Baizley and W. R. Adams, 59, Fleet Street. The arrangements for directors are the same as in the preceding company. Registered 30th ult. Solicitors, Fox and Thicknesse, 11, Abchurch Lane, E.C.

District Messenger Service and News Company, Limited.—Capital £200,000 in £5 shares. To manufacture and supply electrical appliances for transmitting messages, signals, and for other purposes, and to purchase certain letters patent upon terms of an unregistered agreement with Charles Tweed Russell. Signatories (with 1 share each): H. G. Asten, R. B. Smith, A. Lovis, 50, Lime Street; H. Osbornler, 24, Cedars Road, Clapham; G. Macmuldrew, 26, Woburn Place; C. Tweed Russell, 18, Southwell Gardens, South Kensington; W. H. Williams, 60, Felenstowe Road, Kensal Green. The signatories are to appoint the first directors; qualification, £500 in shares; remuneration, £250 per annum each, with £50 additional for the chairman. Registered 30th ult. by Ashurst, Morris, Crisp & Co., 6, Old Jewry.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Electric Light Company, Limited.—An agreement of 19th ult. between this company and John Muirhead and Latimer Clark, cites that the two latter are unsecured creditors of the company for £800, and have agreed to accept 40 fully paid preference shares in satisfaction thereof.

Northern District Telephone Company, Limited.—At an extraordinary meeting of this company, held at Oxford Court, Cannon Street, on the 15th May, special resolutions were passed approving an agreement for the sale of the business and property of the company to the National Telephone Company, Limited, and with a view to giving effect to the same to wind up voluntarily, Mr. Thomas Abercrombe Melton be appointed liquidator. The resolution was confirmed on the 12th ult., and was filed on the 28th ult.

Northampton Electric Light and Power Company, Limited.—The annual return of this company, made up to the 17th ult., was filed on the 24th ult. The nominal capital is £50,000, divided into 10 A and 49,990 B sharas of £1 each. The whole of the former and 10,000 of the latter are taken up. Upon the B shares the full amount has been called, the calls paid amounting to £4,927, and unpaid to £5,073.

Electrical Engineering Corporation, Limited.—At an extraordinary general meeting of this company, held at 3, Prince's Mansions, Victoria Street, on the 8th May, certain alterations were made in the articles of association, one of these fixing the qualification of a director at £500 in shares. The special resolutions were confirmed on the 6th June, and were duly filed on the 23rd June.

General Electric Power and Traction Company, Limited.—An agreement of 22nd May with the Electric Construction Corporation provides for the acquisition by this company of certain license of patents for £30,000 in fully paid ordinary shares.

Railway Electrical Contractors, Limited (in Liquidation).—The registered office of this company is now situate at 1 and 2, Great Winchester Street.

City of Westminster Electrical Syndicate.—The registered office of this company is situate at 4, Victoria Mansion, Victoria Street, Westminster.

New Electric Fire Lighter Company, Limited.—The registered office of this company is situate at the Works, Marsh Gate Lane, Stratford, E.

LEGAL.

Chatenay v. the Brazilian Submarine Telegraph Company.—This case came before Mr. Justice Day, sitting without a jury, on Wednesday. The plaintiff, who resides at Rio, said he was, at the time of his mother's death, the registered holder of 50 shares in the defendant company, whose offices are in London, but since then his name had been removed from the register of shareholders without his consent, and some other person's name had been substituted as the holder of the said shares. The plaintiff had given a power of attorney to his agent, Mr. Bruyere, of London, to act for him, and the question his Lordship was asked to decide was whether Brazilian or English law governed this power of attorney.

Mr. H. D. Greene, Q.C., and Mr. Alexander Young were counsel for the plaintiff; Mr. R. B. Finlay, Q.C., Mr. Graham, and Mr. Calvert were counsel for the defendant.

Mr. GREENE said the defendant wanted to issue a commission to Brazil to take evidence as to the meaning of this alleged power of attorney, contending that Brazilian law would govern the operation of it in this country. Mr. Chatenay, in his deposition, said he had never received dividends on the shares direct, but through his agent in London. Plaintiff was trustee for other members of his family, and he had never authorised anyone to transfer these shares. The learned counsel submitted that under these circumstances Mr. Bruyere's rights under the power of attorney were regulated by English law.

Mr. FINLAY insisted that the document having been executed in Brazil by the plaintiff, a resident in Brazil, it must be governed by the Brazilian law.

His LORDSHIP, at the conclusion of the arguments, held that the power of attorney was a general power, and must be governed by the laws of the country in which it was exercised.

CITY NOTES, REPORTS, MEETINGS, &c.

The West African Telegraph Company, Limited.

THE fifth ordinary general meeting of the shareholders was held at Winchester House on Thursday, the 3rd inst., to receive the directors' report and acccounts, &c., for the year ending 31st December, 1889 (printed in our last issue).

Sir John Pender, K.C.M.G., who presided, said that several new stations for the company's joint working arrangements had been established in the year under review, and that a new cable had been laid between Bonny and Principé. As regards the net result of the year's working, compared with the previous year, the gross revenue amounted to £64,661, as against £55,315, or an increase of £9,346, almost entirely derived from the traffic with South Africa. Communication between the company's line and Cape Town was established on the 4th June last, so that they had only had the benefit of the new traffic for seven months. The South African traffic was worked under a joint purse agreement between the Eastern, the Eastern South African, the Brazilian Submarine, the Spanish National, and this company; and so long as communication was maintained by either coast the company's revenue was secure. The amount brought forward last year amounted to £4,878 4s. 8d. as against £1,215 9s. 11d. in 1888, or an increase of £3,662 14s. 9d. The total expenses in 1889 were £21,155 9s. 8d., and in 1888 they were £20,016 0s. 7d., so that there was an increase of £1,139 9s. 1d., which was due almost entirely to the causes he had mentioned. The hire of cable repairing ships—viz., £1,780 3s. 1d., was charged to the current revenue account, and a balance of preliminary expenses, £750, was written off. A fair amount had been written off for depreciation of cable stock. The net result of 1888, after providing for expenses, interest, and a sinking fund for the redemption of 5 per cent. debentures, had been a dividend of 2½ per cent. per annum, £5,000 to repairs and renewals account, and £4,878 4s. 8d. carried forward. This time they declared a dividend of £5 per cent. for the year, and they charged repairs and renewals to the revenue account, and they carried to the general reserve fund the sum of £16,145 11s. The balance to the credit of repairs and renewals, £3,074 2s. 5d., has been carried to the general reserve fund, so that the interest on investments added to the general reserve fund amounted to £19,712 18s., fully invested. This, he thought, was a fulfilment of the promise made by him twelve months ago. In 1887 they had no dividend, in 1888 the dividend was 1½, in 1889, after the reconstruction of the Board, the dividend was 2½ per cent. He believed that the company was destined to play a very important part in the opening up of the "dark continent." Referring to the Telegraphic Conference lately held in Paris, he claimed that the result was on the whole that the cable companies held a higher position than probably they had ever done in the estimation of the public and continental governments. He admitted they were fairly treated on the whole, although the tendency was to reductions, in which they must bear their share, whilst they consoled themselves with the thought that reductions very often lead to increased traffic. He moved the adoption of the report and accounts, and the declaration of a dividend, payable on and after that date, of 6s. 6d. per share, free of income tax, making, with the interim dividend already paid, a total distribution for the year of 5 per cent.

The motion was carried unanimously, Sir John Pender and Mr. R. K. Gray were re-elected directors, the appointment of Mr. J. Denison Pender as a director was confirmed, and Messrs. Deloitte, Dever, Griffiths & Co. were reappointed auditors of the company, and with a vote of thanks to the chairman and directors the proceedings came to a close.

The National Telephone Company, Limited.

THE report of the directors to be presented at the tenth ordinary general meeting, to be held at the Cannon Street Hotel on Friday, 11th July, at 12 o'clock, states:—The directors have the pleasure of submitting to the shareholders the accounts for the year ending 30th April, 1890, showing a balance to the credit of net revenue account of £183,375 19s. 7d., after providing for the amalgamation expenses, and the accrued interest on the debentures and new shares. Of this amount the sum of £66,131 5s. has been absorbed by the payment of an interim dividend on the preference and ordinary shares at the rate of 6 per cent. per annum for the first six months of the year. The directors propose to pay a further dividend on both classes of shares at the rate of 6 per cent. per annum for the last half of the year, which will absorb a further sum of £66,131 5s., and leave a balance still on hand of £51,113 9s. 7d. In view of the near expiration of the company's patents, the directors think it prudent to strengthen the reserve account, and they propose, under article 113 of the articles of association, to transfer to this account £40,000, leaving £11,113 9s. 7d. to be carried forward to next year. The extension of the company's business during the past year has been very satisfactory, the gross annual rental from exchange, trunk, and private lines having increased from £343,544 1s. 1d. on the 30th April, 1889 (prior to the amalgamation), to £392,541 19s. 1d. on the 30th April, 1890, an increase in the year of £48,997 18s. The important trunk lines connecting London with the principal towns in the Lancashire, Yorkshire, and Midland districts were completed as far as Edgware in January last, and the service proved to be perfectly clear and distinct. Some difficulty was then experienced in running the wires through to London, which was not overcome in time to have the connection completed before the issue of this report. The directors have every confidence that the communication between London and the North will be established by the end of this month. A large number of additional trunk lines connecting various towns in the provinces have also been commenced during the year, many of which have been completed. These trunk lines supply a much-felt public want, and will add greatly to the strength of the company. The directors believe it most important to continue the policy of developing and improving the company's system, and of giving greater facilities to the public. The capital required for this purpose the directors propose to raise by the issue of debenture stock or preference shares, as may be found best for the interests of the company. The accrued rental for the year ending 30th April, 1890, was £364,704 17s. 5d., an increase of £45,162 over the accrued rentals of the National, United and Lancashire and Cheshire Companies for the year before the amalgamation. The working expenses for the year ending 30th April, 1890, amount to £148,457 0s. 9d., being 40·7 per cent. on the accrued rental, whilst the working expenses of the three companies before the amalgamation were

47·7 per cent. This saving of 7 per cent. is owing to reductions of working expenditure rendered possible by the amalgamation. The directors have taken over the business of the Northern District Telephone Company, Limited, which is now merged in this company. The Postmaster-General not having given notice to purchase the company's business under the power reserved by the terms of his licence, is not now entitled to do so for another period of seven years. The auditors, Messrs. Welton, Jones & Co., retire, and are eligible for re-election.

The Electric Engineering Company of Ireland.

The first statutory meeting of the Electric Engineering Company of Ireland was held last week in the board room, Dawson Street, Sir Howard Grubb, F.R.S., presiding. The company was registered on the 5th March, 1890. The prospectuses were issued to the public on the 8th, and 6,800 £2 shares were allotted to the public and vendors.

The Chairman said the company had obtained some good contracts, and the great number of estimates which they had been asked to furnish not only gave good promise for the future, but showed very clearly that the establishment of such a company was a necessity in Dublin. However, there were many causes to check its immediate development. The acceptance of many of the estimates applied for had been made contingent on the starting of the general electric lighting scheme proposed by the Corporation of Dublin, the arrangements for which were not quite complete, and the period within which it would be available for the general public was therefore uncertain. If no such scheme had been contemplated, many business houses would be prepared to erect private installations; but so long as the matter remained uncertain, they could not expect intending users to lay out money on private installations. Again, the public required to be further educated as to the advantage of electric lighting. Up to the present the question which users invariably asked was simply, Will my gas or my electric light bill be the heavier at the end of the year? But he thought the time was coming when in comparing the relative advantages of the systems the public will learn to place the doctors' bills, deterioration of furniture, decorations, books, &c., on the right side of the account, and perhaps by that time would be getting a little tired of the oft-repeated story of the electrically-frizzled horse. Perhaps he might be allowed to mention one specific case which had come under his own immediate ken. In an institution in which he frequently had business, he happened to know that a sum of £50 was added to the decorator's estimates for the purpose of doing some gilding to the ceiling and cornices of one particular room. Judging by the effect already produced, though the gas was seldom used in that room, this would not last for many years, whereas if electric light were in use it would be good for 50 years; also, he understood that a considerable sum of money would have shortly to be expended in the rebinding of books, the backs of which had been completely destroyed by the products of the gas. In this particular case it would certainly have been much cheaper to have used electric light than gas, even if the latter had been supplied without any charge whatever. Again, electric light installations had been frequently undertaken by firms wholly without the required technical knowledge or the means of obtaining it, result being that the work has been done in an inefficient manner. In this company there was no mixing up of electric light with any other business. They had an efficient staff of electric engineers, all of whom had held positions under some of the largest and best known electric light companies now working, in addition to which, in case of any work of great magnitude, they had the advantage of the experience of one of the oldest, largest, and most successful electric lighting companies in the world—viz., the Brush Corporation of London. The temptation in the case of inexperienced firms, particularly when there is much competition, was to promise too much, and to cut down the estimates as closely as possible to secure the order. Their board did not believe in the wisdom of endangering the future reputation of the company for the sake of a possibly increased show of work in the present; nor did they propose to undertake work (for advertising or other such purposes) which would not pay a reasonable profit. In conclusion, the chairman pointed out the advantages to health from the use of electric light instead of gas, and quoted from an article which appeared in the *Daily News*, and in which it was stated that since the installation of electric light in the Post Office, there had been a saving of £600 a year effected, owing to the decrease of leave of absence to the members of the staff who were ill.

Sir H. Grubb was re-elected chairman, and Messrs. George F. Fitzgerald, Thomas J. Haslam, Emile Garcke, David Sherlock, and J. H. North directors, and a sum of £200 per annum was agreed to be set apart as the remuneration for the directors other than the managing director.

Messrs. Harrison and Nichols were elected auditors to the company.

A Shareholder asked why the contract for the lighting of the New Science and Art Museum had not been obtained by the company?

The Chairman said the contract had been closed before the company was incorporated.

M. Emile Garcke, secretary of the Brush Electric Company, London, was moved to the second chair, and a vote of thanks was passed unanimously to Sir Howard Grubb for presiding.

Sir Howard Grubb having responded, the proceedings terminated.

Maxim-Weston Electric Company, Limited.

A meeting of the shareholders of this company was held at Winchester House, on Wednesday, to consider the present condition of the company. Our own reporter was refused admission, but we are enabled to give the following report:—

The Chairman (Mr. Gooding), after giving some facts as to the value of the stock, machinery and assets of the company, stated that there had been a great reduction in the working expenses. The directors had not taken, and did not intend to take, any fees pending the decision in Mr. Watt's action. In the past the electric lighting companies had paid enormous sums for patents which were of little value, and that had rendered difficult their successful development. The Maxim-Weston Company had several complete installations, and were supplying plant, &c., not only in this country, but in Ireland, and were continually receiving enquiries for tenders, but it was somewhat difficult to carry on negotiations because they were hampered for want of capital. The directors have shown great faith in the company and he hoped the shareholders would do the same, and find the necessary money to carry the company on successfully.

Mr. Hodgson (a new director), on being asked his opinion of the company, stated that since he had been on the board he had given a great deal of time and consideration to its affairs, and believed that, without any great outlay, they could carry out the electric lighting on a large scale very successful. He should have no hesitation in subscribing more capital.

Several shareholders, after a short discussion, expressed their willingness to contribute in the way of debentures.

The Chairman stated that he and the other directors were prepared to do likewise. The meeting was of an informal character and no resolution could be passed, but the directors and a number of shareholders having agreed to subscribe capital it would, he said, be done by way of floating debentures with security on the works of the company.

The India-Rubber, Gutta-Percha, and Telegraph Works Company, Limited.—A half-yearly general meeting of the company will be held at the Cannon Street Hotel, London, on Thursday, the 10th inst., at 12 o'clock noon, for the purpose of obtaining the sanction of the shareholders to the payment of an interim dividend of 5 per cent., or 10s. per share, free of income tax. The company's share register will be closed till the 10th inst.

The Eastern Extension, Australasia, and China Telegraph Company, Limited.—This company notifies that the coupon on their 5 per cent. Australian Government subsidy debentures, due on July 1st, will be paid on and after that date, at the banking house of Messrs. Barclay, Bevan & Co., 54, Lombard Street, E.C. The directors have also declared an interim dividend of 2s. 6d. per share, tax free, payable on the 15th inst.

The United Electrical Engineering Co., Limited, in Liquidation.—By notice in the *Gazette*, June 27th, creditors of the company are required on or before July 26th, 1890, to send their names and addresses, particulars of their debts or claims, and the names and addresses of their solicitors (if any) to Alfred Sydney Gedge and William Leonard Madgen, the liquidators, No. 3, St. James Street, Bedford Row, Middlesex.

The Automatic Electric Railway Signal Company, Limited.—By an Order of the High Court, Chancery Division, dated 21st June last, on the petition of Blakey, Emmott and Co., Limited, of Square Road, Halifax, York, creditors of the company, it was ordered that the winding up of the company be continued, subject to the supervision of the Court.

Western Counties and South Wales Telephone Company, Limited.—At an extraordinary meeting of this company, held on Friday last, the resolution passed at the meeting of May 30th, for the alteration of the articles of association, was confirmed.

The American Bell Telephone Company.—The directors have declared an extra dividend of 6 per cent., in addition to the regular 3 per cent.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company. The receipts for the month of June were £3,300, as compared with £3,397 in the corresponding month of last year. The receipts for the month of March, estimated at £4,000, realised £4,018.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of June were £2,085, against £1,600 in the corresponding period of last year.

The Eastern Extension, Australasia and China Telegraph Company, Limited. The receipts for the month of June, 1890, amounted to £43,198, an increase of £3,848.

The Eastern Telegraph Company, Limited. The receipts for the month of June, 1890, amounted to £51,019, an increase of £6,214.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending June 27th, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,216.

The West Coast of America Telegraph Company, Limited. The gross earnings or the month of June, 1890, were £5,475.

West India and Panama Telegraph Company, Limited. The estimated traffic receipts for the half month ended the 30th June, are £3,127, an increase of £353.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation. (June 25).	Closing Quotation. (July 3.)	Business done during week ending July 3, 1890.	
					Highest.	Lowest.
£ 250,000	African Direct Telegraph, Ltd., 4 p. c. Deb. Regd. and to Bearer	100	99 —102	97 —100 xd	100	99¾
1,549,160	Anglo-American Telegraph, Limited	Stock	50 — 51	50 — 51	51	...
2,725,420	Do. do. 6 p. c. Preferred	Stock	86 — 87	86 — 87	87	86⅞
2,725,420	Do. do. Deferred	Stock	14¾— 15¼	14½— 15	14⅞	...
130,000	Brazilian Submarine Telegraph, Limited	10	11¾— 12¼	11¾— 12 xd	12	$11\frac{15}{16}$
99,000	Do. do. 5 p. c. Bonds...	100	101 —103	101 —103		
75,000	Do. do. 5 p. c. 2nd Series, repayable June, 1906	100	106 —109	103 —107 xd		
63,416	Brush Electric Engineering Ordinary, Nos. 1 to 63,416... ...	3	2¼— 2½	2¼— 2½	2⅜	2⅛
63,416	Do. do. Preference, Nos. 1 to 63,416 ...	2	1¾— 2	1¾— 2	$1\frac{15}{16}$	1¾
224,850	Consolidated Telephone Construction and Maintenance, Ltd. ...	14/-	½— ⅝	½— ⅝	⅝	...
20,000	Crompton & Co., Limited, 7 p. c. Pref. Shares, Nos. 1 to 20,000	Stock	5¼— 5¾	5¼— 5¾		
16,000	Cuba Telegraph, Limited	10	12 — 12½	12 — 12½	12½	...
6,000	Do. do. 10 p. c. Preference	10	17 — 18	17 — 18		
12,931	Direct Spanish Telegraph, Limited ... (£4 only paid)	5	3¾— 4¼	3 — 4	$3\frac{5}{16}$	3
6,090	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10		
60,710	Direct United States Cable, Limited, 1877	20	10⅛— 10⅜	10⅛— 10⅜	10⅜	$10\frac{5}{16}$
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14 — 14¼	14 — 14¼	$14\frac{5}{16}$	14
70,000	Do. 6 p. c. Preference	10	15 — 15½	15 — 15½	15½	$15\frac{5}{16}$
200,000	Do. 5 p. c. Debs. (1879 issue), repay. Aug., 1899	100	108 —111	108 —111		
1,200,000	Do. 4 p. c. Mortgage Debenture Stock	Stock	106 —109	106 —109	108	...
250,000	Eastern Extension, Australasia and China Telegraph, Limited	10	14¼— 14½	14¼— 14½	14½	14¼
320,000	Do. 6 p. c. Debentures, repay. February, 1891	100	101 —103	101 —103		
446,100	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. ...	100	104 —107	103 —106 xd		
12,500	Do. 5 p. c. Debentures, 1890, redeem. ann. drawings ...	100	103 —106	103 —106 xd	104¼	...
367,900	Eastern and South African Tel., Ltd., 5 p. c. Mort. Deb., 1900...	100	102 —105	100 —103 xd		
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	4¾— 5¼	4¾— 5¼		
46,700	Elmore's Patent Copper Depositing, Ltd., Nos. 23,001 to 70,000	2	5¾— 6¼	5½— 6	$5\frac{11}{16}$	$5\frac{5}{16}$
19,700	Fowler-Waring Cables, Nos. 301 to 20,000 ...(£3 only paid)	5	2¼— 2¾	2 — 2½		
180,227	Globe Telegraph and Trust, Limited	10	8⅞— 9⅛	9 — 9¼	9¾	9
180,042	Do. do. 6 p. c. Preference	10	15 — 15¼	15 — 15¼	15¼	15
150,000	Great Northern Tel. Company of Copenhagen	10	15¾— 16¼	15¾— 16¼xd	16¼	15¾
40,000	Do. do. 5 p. c. Debs. (issue of 1881) ...	100	102 —105	100 —103 xd		
250,000	Do. do. do. (issue of 1883) ...	100	104 —107	104 —107		
9,334	Greenwood and Batley, Ltd., Ordinary, Nos. 4,667 to 14,000 ...	10	12 — 13	12 — 13		
5,334	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	11½— 12½	11½— 12½	12⅛	...
41,600	India-Rubber, Gutta-Percha and Telegraph Works, Limited ...	10	19 — 20	19 — 20		
200,000	Do. do. 4½ p. c. Deb., 1896...	100	103 —105	103 —105		
17,000	Indo-European Telegraph, Limited...	25	37 — 39	37 — 39		
38,348	London Platino-Brazilian Telegraph, Limited	10	6 — 7	6 — 7		
100,000	Do. do. do. 6 p. c. Debentures ...	100	107 —110	107 —110	108¾	108
49,900	*Metropolitan Electric Supply, Limited, Nos. 6,101 to 50,000 ...	10	5¼— 5¾	4¾— 5¼	5⅛	5
386,875	National Telephone, Limited, Nos. 1 to 386,875	5	5½— 5¾	5½— 5¾	$5\frac{15}{16}$	5⅝
49,825	Do. New Nos. 386,876 to 436,700	5	5 — 5½	5⅜— 5⅝	$5\frac{9}{16}$	5½
15,000	Do. 6 p. c. Cum. 1st Preference	10	12½— 13	12½— 13	13	$12\frac{13}{16}$
15,000	Do. 6 p. c. Cum. 2nd Preference (£8 only paid)	10	10¼— 10¾	10¼— 10¾		
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11/- only paid)	1	¼— ⅜	¼— ⅜		
9,000	Reuter's, Limited	8	7¾— 8¼	7¾— 8¼		
209,750	South of England Telephone, Ltd., Ordinary, Nos. 1 to 2,000, 2,501 to 3,500, 93,251 to 300,000	1	¼— ...	¼— ...		
20,000	Do. 6 p. c. Cum. Pref., Nos. 1 to 20,000 (£3½ only paid)	5	3 — 3½	2¾— 3¼		
3,381	Submarine Cables Trust	Cert.	112 —116	112 —116		
78,949	Swan United Electric Light, Limited ... (£3½ only paid)	5	5¼— 5¾	5¼— 5¾	$5\frac{9}{16}$	5⅛
37,350	Telegraph Construction and Maintenance, Limited	12	44 — 46	44 — 46	45½	..
150,000	Do. do. do. 5 p. c. Bonds, red. 1894	100	101 — 104	100 —102 xd		
55,000	United River Plate Telephone, Limited	5	4½— 5	4½— 5		
146,000	Do. do. 5 p. c. Debenture Stock... ...	Stock	90 — 94	90 — 94 xd		
100,000	Do. do. 7 p. c. Debs., Nos. 1 to 1,000 ...	100	... ...	... ... xd		
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	9½— 10½	9½— 10½	10	...
300,000	Do. do. do. 5 p. c. Debentures	100	99 —102	99 —102	101	...
30,000	West Coast of America Telegraph, Limited	10	6½— 7	6 — 6½	6⅝	...
150,000	Do. do. do. 8 p. c. Debs, repay. 1902 ...	100	111 —116	108 —112 xd		
64,572	Western and Brazilian Telegraph, Limited	15	10 — 10½	10 — 10½	10⅛	10
26,986	Do. do. do. 5 p. c. Cum. Preferred	7½	6½— 7	6½— 7	6⅞	6⅝
26,986	Do. do. do. 5 p. c. Deferred	7½	3½— 4	3½— 4		
200,000	Do. do. do. 6 p. c. Debentures "A," 1910...	100	106 —109	106 —109		
250,000	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	104 —107	104 —107	104½	...
88,321	West India and Panama Telegraph, Limited	10	2⅜— 2⅝	2⅜— 2⅝	2½	2⅜
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	11 — 11½	11 — 11½	11¼	11⅛
4,669	Do. do. do, 6 p. c. 2nd Preference ...	10	12½— 13½	12½— 13½	12⅝	...
1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mort (Building) Bonds	$1,000	120 —125	120 —125	122	...
179,300	Do. do. 6 p. c. Sterling Bonds	100	99 —101	99 —101		
42,853	*Westmstr. Elec. Sup. Corp., Ord., Nos. 101 to 42,953 (£2 only paid)	5	1¾— 2¼	1¾— 2¼		

* Subject to Founders Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 7⅛—7⅜.—Electric Construction Corporation (£10 paid), 9¾—10¼.—House-to-House Company (£5 paid), 5—5¼.—London Electric Supply Corporation, Ordinary (£5 paid), 2½—2¾.—Manchester Edison and Swan Company, £9, (£1 paid), 11/- —12/-.

BANK RATE OF DISCOUNT.—4 per cent. (26th June, 1890).

THE LINEFF TRAMWAY MAGNETIC CONDUCTOR.

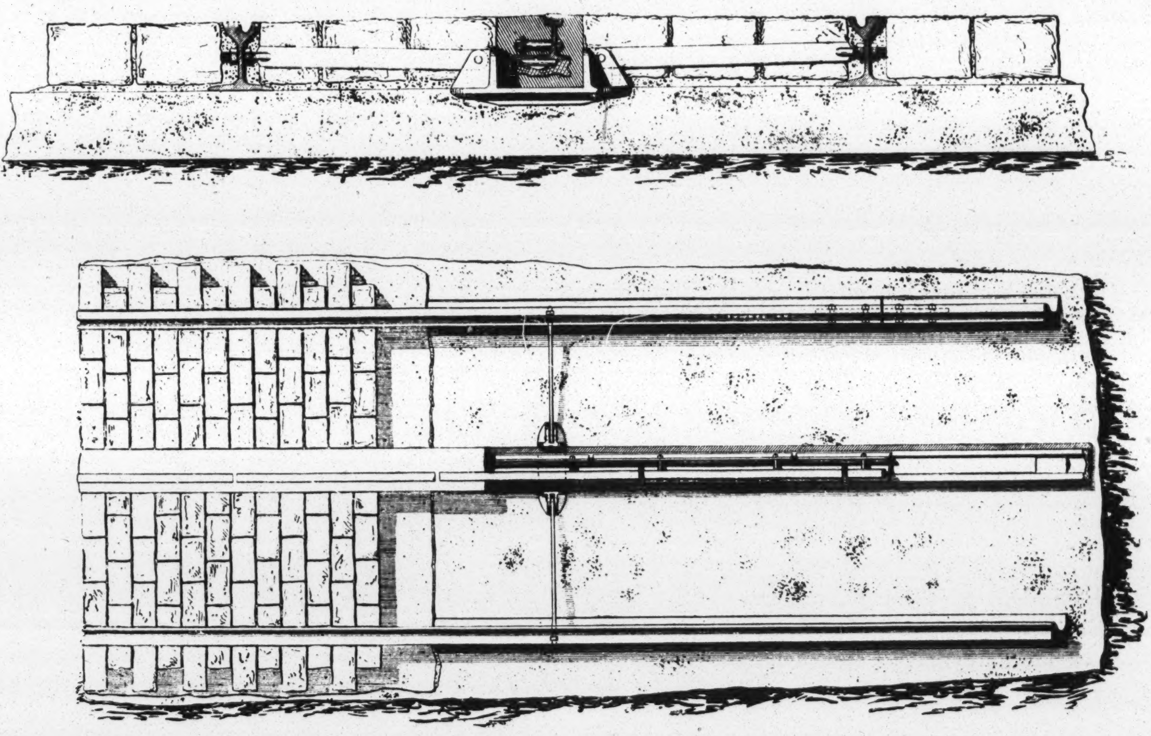
ALTHOUGH we have described the Lineff system in a previous issue, we have been requested to insert the following in our present issue:—

The new Lineff conductor for tramways is the first which has practically taken advantage of the force of magnetism, in closing the circuit in electric traction. The surface rails are laid in lengths of about 3 feet in a bed of asphalte, and as they are without any groove, and have their upper surface flush with the roadway, they cannot form any obstruction to traffic either along or across the track. In point of fact they are hardly to be distinguished from the roadway itself.

Each of these rails is bolted by means of brass bolts and distance pieces to a piece of tee iron of equal length, so placed as to have its base on the same level as that of the surface rails, at a distance from it of about a quarter of an inch. The tee iron being of lower height than the surface rail does not appear at all on the roadway, being completely buried in the asphalte surrounding the whole. One end of the tee iron projects beyond the corresponding end of the surface rail, so that the rails when laid in position break joint with one another all along the road.

MAGNETIC CONDUCTOR FOR TRAMWAYS: LINEFF'S PATENT.

CENTRAL ARRANGEMENT.



The two irons together form a roof to a continuous channel 3¼ inches wide, formed by insulating tiles, on which the irons rest. This channel contains the bare copper main, shown in the drawing as a flat strip, and on this rests a flexible hoop iron 3 inches wide, which is free to rise into contact with the lower flanges of the surface and tee rails, from which it is in its normal position distant about $\frac{5}{16}$th inch.

Each car carries underneath it an electro-magnet, each pole of which contains a solid iron wheel which runs on the surface rail. The distance between the pole pieces is slightly greater than the length of one section of the surface rail, so that the two poles are never on the same section.

The magnet is energised by the main current, the wire forming the coils being coupled in shunt with the motor circuit.

The magnetic lines emanating from the magnet poles pass into the surface rail. The section of this being insufficient to carry the whole of the magnetic lines, a large proportion of them leak across to the buried tee rails, and as the connection between each pair of rails (surface and buried) is of a non-magnetic material, the lines jump across the air space between the lower flanges. Opposite poles are consequently induced in each of the surface and tee rails under the immediate influence of the electro-magnet, and the leakage "cross" lines, being diverted through the strip of hoop iron lying immediately below the air gap, in their attempt to shorten themselves attract the hoop iron into contact with the bases of the surface and tee rails; both of which, as they are in electrical (though not in magnetic) connection assist in taking off the current.

ROYAL AGRICULTURAL SHOW.

THE annual show of the Royal Agricultural Society of England was held at Plymouth from the 21st to 27th June. In the machinery department were a number of exhibits possessing considerable interest as illustrating the increasing attention given by makers of engines and electrical machinery to the special requirements of country houses and large farms. Amongst them the premier place must be assigned to the joint exhibit of the *Priestman* oil engine and *Mr. Newton's* collection of machinery and apparatus for electric lighting and transmission of power, including the "Taunton" dynamo. The stand itself was ornamented with art drapery, and fitted up with a variety of lamps and shades. It attracted crowds of investigators, many of whom made on this occasion their first acquaintance with the electric light and the method of its production. Everything was open to inspection, and from an educational point of view the exhibit was a most useful one. The oil engine run by Messrs. Priestman Brothers was a 2 H.P. horizontal, and the "Taunton" dynamo was a 30-lighter, a set of accumulators being also employed in order to illustrate their use. A portable oil engine, 11 H.P., mounted on wheels, with shafts, was also shown driving a thrashing machine, and convincing the spectators of its suitability for such purposes. Messrs. Priestman Brothers have been awarded the first prize at this show for a small farmer's motor, and we are glad to hear that they are busy with orders in hand for home and abroad for their oil engines which are rapidly coming to the front as a motive power. According to the catalogue there should have been exhibited at one of the stalls a self-regulating dynamo, 5 unit, suitable for transmitting power to a motor for driving dairy and other machinery on a farm, as well as two electric motors suitable for driving farm machinery, made by *Mr. J. E. Veale, of St. Austell's*, but in reality only the dynamo was on view, and that not working. At the stand of *Messrs. Gilbert Gilkes & Co.*, amongst other turbines, one was shown operating a small Gülcher dynamo. Amongst the "new implements" a magnetic separator and dynamo was exhibited by *Mr. J. Harrison Carter*, intended to surmount the serious obstacles attending the use of old toothed bone mills or disintegrators arising from the frequent presence of iron with the bone.

Messrs. John Fowler & Co., Leeds, exhibited what they have named the "Yorkshire" engine, horizontal, compound, 12 H.P., fitted with automatic expansion gear on both cylinders controlled by one governor, and specially constructed for driving dynamos or other machinery requiring steady driving. Another engine specially constructed for the same purpose, and shown by *Messrs. Ransomes, Sims and Jefferies*, was a 10 H.P. compound "Undertype" with patent automatic expansion gear. At *Messrs. Robey & Co.'s* stand was a vertical high speed engine, with cylinder 6½ inches diameter by 6 inches stroke, working at a pressure of 80 lbs., a very suitable engine for small electric light installations or for ship lighting.

Messrs. Davey, Paxman & Co., of Colchester, exhibited an improved compound portable steam engine and an improved single-cylinder portable steam engine, both of which were selected by the jurors for driving the various machines sent for competition. This we consider a great compliment to the makers. The steady running of these engines leaves nothing to be desired. The makers have maintained for very many years (in spite of much opposition), that first rate results can be obtained with compound engines working without condensers, and the performance of the one at present under consideration fully establishes all their arguments in favour of this class of engine.

The boiler is of the locomotive type with an improved firebox. The engine is complete in itself, being built on a steel channel frame which is securely bolted to brackets on the boiler. By merely removing a few bolts the whole engine and frame can be lifted from the boiler, and if so desired, fixed and worked separately.

Both engines are fitted with the Paxman automatic gear which has gained a world-wide character by the way in which it controlled the engines used for electric lighting at the various exhibitions, and especially in Paris.

The compound engine works at a pressure of 140 lbs. and the nominal horse-power is 8 H.P. The high pressure cylinder is 5½ inches in diameter, and the low one 9 inches. These sizes are such that the powers developed by the cylinders, separately, are about equal when working with a fair load. The stroke is 14 inches.

The other portable engine exhibited by this firm, viz., the single cylinder one, is of a different pattern. The cylinder is bolted on to the firebox, and the crankshaft is supported by two brackets bolted to the barrel of the boiler. The barrel of the boiler is lagged and the cylinder steam-jacketted. This engine is nominally of 8 H.P. but it will work up to 20 H.P., the diameter of the cylinder being 9½ inches and the stroke 12 inches. Both these engines are mounted upon wrought iron carriages and supported by wrought iron wheels of a simple and very strong design. They consist of a number of spokes of wedge shaped loops of iron, the free ends of which are cast into the centre, the sides of which are rivetted together. A wrought iron rim is shrunk on and rivetted to the outside of the loops.

The Knight paraffin oil engine, shown for the first time at the Windsor show last year, was exhibited this year by the makers, *Messrs. Brown & May*, who call attention to the fact that this engine works without electricity, and as only one kind of oil is used for starting and working, the cost and trouble is reduced to a minimum. It is said to be well adapted for driving electric light machinery, especially where the saving of space is important. The Forward gas engine was also on the ground, as well as the new gas engine (Fielding's patent), lately introduced by the makers, *Messrs. Fielding & Platt.* The special feature of this engine is said to be its simplicity, as it has fewer working parts than any other in the market. Its working is silent and regular and the wear and tear very slight.

COUNTY COUNCIL AND ELECTRIC LIGHTING.

NUMEROUS EXTENSIONS SANCTIONED.

LONDON ELECTRIC SUPPLY CORPORATION.

AT the weekly meeting of the London County Council on Tuesday last week, in the County Hall, Spring Gardens (the Earl of Rosebery in the chair), Mr. T. B. Westacott, the Chairman of the Highways Committee, submitted a report recommending the council to sanction the laying of mains by several electric lighting companies. The various recommendations were approved without discussion. The committee reported that they had "considered a notice (Registered No. 90) from the London Electric Supply Corporation, dated 4th June, 1890, of intention to lay trunk mains from Cockspur Street through the Haymarket, Glasshouse Street, Vigo Street, Burlington Gardens, Cork Street, Clifford Street, and Bond Street, to the company's station at the Grosvenor Gallery, as shown upon a plan submitted with the notice. In some of these streets the St. James's and Pall Mall Electric Lighting Company has already laid low-tension mains, and it appears to your committee advisable that the proposed trunk mains of the London Company should be laid beneath these. There seems to be no objection to the works, provided that proper means are taken for the protection of the mains; and your committee recommend—'That the sanction of the council be given to the works referred to in the notice (Registered No. 90), dated 4th June, 1890, of the London Electric Supply Corporation, on condition that in the streets where the St. James and Pall Mall Electric Lighting Company has already laid mains, the trunk mains referred to in the notice be laid beneath them; that the mains be protected from external injury by a sufficient outer covering, to the satisfaction of the council's engineer; and that the company do give three days' notice to him before commencing the works in any of the thoroughfares referred to in the notice.'"

A further notice (No. 91) of the same company to lay trunk mains in a part of Snow Fields, Bermondsey, was conditionally sanctioned.

The committee also reported:—"The company has given a further notice (Registered No. 92), dated 11th June, 1890, with one plan, of its intention to lay trunk mains in Newcomen Street, Union Street, Charlotte Street, Blackfriars Road and Cross Street; and the company asks that this may be substituted for the notice (Registered No. 61), dated 18th April, 1890, with reference to trunk mains across Borough High Street and Blackfriars Road, and through Southwark Street and Stamford Street, to which the council gave its sanction on 6th May last, at the same time requiring that the mains in Southwark Street should be laid in the subway there. It does not appear to your committee desirable that the council should interfere with the discretion of the company as to the route to be adopted for its trunk mains; but they are of opinion that the company may reasonably be required to lay its distributing mains at the same time as the trunk mains, in order to avoid a second interference with the same streets. Your committee, having given careful consideration to the matter, recommend—'That the sanction of the council be given to the works referred to in the notice (Registered No. 92) of the London Electric Supply Corporation, dated 11th June, 1890, on condition that the distributing mains be laid at the same time as the trunk mains in order to avoid a second interference with the same streets, and subject also to the same conditions regarding protection of the mains and notice of commencement of works as in the case of the two preceding notices.'"

WESTMINSTER ELECTRIC SUPPLY CORPORATION.

The committee's report as to this company was as under:—"The Westminster Electric Supply Corporation has given a notice (Registered No. 94), dated June 9th, 1890, with one plan, of its intention to lay mains in the following streets, viz.:—Park Lane, Hamilton Place, Hereford Gardens, North Row (part of), Green Street, Upper Brook Street, Upper Grosvenor Street, Mount Street, Tilney Street, Great Stanhope Street, Park Street, North and South Audley Streets, Grosvenor Square and Street, George Street (Oxford Street), Hart Street, Duke Street, Robert Street, Brook Street, Oxford Street (part of), South Molton Lane (part of), Hertford Street, Brick Street, Piccadilly, Hyde Park Corner, Down Street, Curzon Street, Chapel Street West, Queen Street, Carlos Street, Union Street (part of), Bolton Street and Row, Clarges Street (part of), Half Moon Street, Stratton Street, Berkeley Square and Street, Davies Street, Hay Hill, Bruton Street, Dover Street, Grafton Street, Arlington Street, Park Place, St. James's Street, Bennett Street, Albemarle Street, Old and New Bond Streets, Tenterden Street, Hanover Square and Street, George Street (Hanover Square), Maddox Street, Conduit Street, Prince's Street, Harewood Place, Swallow Place, Hill

Street and Stafford Street. These works are similar to those of the same company which have already been sanctioned by the council; and your committee recommend—'That the sanction of the council be given to the works referred to in the notice (Registered No. 94), dated June 9th, 1890, of the Westminster Electric Supply Corporation, on condition that the company do give three days' notice to the council's engineer before commencing the works in any thoroughfare; that the mains be laid under the footways wherever it is found practicable to do so; that the York stone covering for culverts under 20 inches wide be not less than 2 inches thick, and for wider culverts 2½ inches; and that where it is found necessary to lay the culverts under the carriage ways there shall be not less than 9 inches of Portland cement concrete between the cover stones of the culverts and the under side of the paving.'"

This recommendation was also approved, as were two others, sanctioning the laying of mains in Kensington Park Road, Victoria Gardens, Ladbroke Grove, and Horbury Crescent by the Notting Hill Electric Lighting Company; and in Brompton Road (part of), Ovington Square, and across Fulham Road by the Chelsea Electricity Supply Company.

THE SUBWAYS AND OVERHEAD WIRES BILL.

Mr. Charles Harrison, the Chairman of the Parliamentary Committee, submitted a long report respecting the London Subways and Overhead Wires Bill, and after some remarks as to the preamble and the opposition to the Bill when in committee, proceeded as follows:—"The Committee of the House decided to adopt the scheme of the report of 1885, and, in consequence, has conferred on all the local authorities, including the Commissioners of Sewers of the City of London, the duty of administering in their respective districts the bye-laws to be framed by the council. The Bill, as amended, provides that the council may, from time to time, make and vary bye-laws and regulations with respect to any of the following matters—The position and manner in which wires shall be placed in subways; the manner in which any repairs or alterations in any such wires may be made; the control and regulation of persons resorting to any such subway, and all persons fixing or altering any wire therein; the preparation, deposit, and correction of particulars of wires; the identification of overhead wires by registration or otherwise; the regulation of wires; the strength of the materials to be employed in placing, maintaining, and supporting wires; and the removal of wires erected or placed otherwise than in accordance with such bye-laws and of disused wires. These bye-laws are to be enforced by the local authority, except in so far as they may relate to any subway of the council, in which case they are to be enforced and administered by the council. Power is also given to the council (by obtaining an order of the Board of Trade) to enforce the bye-laws, in case of inadequate enforcement of them, or want of uniformity in the method of administering them, by the local authorities."

ELECTRIC LIGHTING ORDERS.

The committee further reported:—"It has been intimated by the Board of Trade that the following electric lighting orders will not be proceeded with:—Metropolitan Electric Supply Company, Limited (City of London); London Electric Supply Corporation Electric Lighting (City) Order; Fulham and Hammersmith (House-to-House) Electric Supply Order; Paddington Electric Supply Order."

"On the 3rd instant we were authorised by the Council to present a petition against any electric lighting order in any confirming Bill which does not in effect comply with the council's resolutions of the 28th January and 22nd April, 1890. The solicitor has drawn our attention to the Electric Lighting Provisional Order Confirmation Bill, No. 9, which contains the five following provisional orders:—Lambeth Electric Supply Order; North London Electric Supply Order; St. James's Electric Lighting Order; London Electric Supply Corporation Electric Lighting (Metropolitan) Order; and Wandsworth District Electric Supply Order. We are advised that it is unnecessary to present a petition against any of these orders in the House of Commons, and we propose to reserve opposition, should it become necessary, for the House of Lords."

GENERATION, DISTRIBUTION AND MEASUREMENT OF ELECTRICITY FOR LIGHT AND POWER, APPLIANCES THEREFOR, AND PARTICULARS OF CANADIAN INSTALLATIONS.*

By A. J. LAWSON, M. Can. Soc. C.E., A.I.E.E., A.M.A.I.E.E.

Concluded from Vol. 26, p. 736.

The Royal Electric Company's Dynamo.

Sometimes the machines of the Royal Electric Company for A. C. work are made with the exciter on the same shaft, but more frequently the exciter is separate. In the 1,200-light dynamo with separate exciter, the active iron in the fields weighs about 3,400 lbs., and the iron rings of the armature (which is a hollow cylinder built up of laminated wrought iron) weigh 1,250 lbs. The radial depth of these rings is 5-inch. When turned up ready for winding the armature is 24⅝-inch diameter and 18½-inch long. The diameter when wound is 25⅛-inch over the bands, and, as the internal diameter of the field bobbins is 25½-inch, there is a clearance of full $\frac{3}{16}$-inch all round. The fields are wound with 845 lbs. of No. 8 B. & S. gauge wire; the armature winding consists of 32 lbs. of No. 11 B. and S. gauge wire. The speed of the machine is 1,200 revolutions per minute, and the exciting current at full load is 24 ampères and 90 volts—say, 2,160 watts, or nearly 3 E.H.P. The standard output of the machine is 70 ampères and 1,020 volts, or 7·5 watts per lb. gross weight: 81·41 watts per lb. of the total copper wire, and 2,231 watts per lb. of the wire on the armature.

RATE OF ALTERNATION OR PERIODICITY.

In the Brush dynamo the periodicity is 110, while in the Fort Wayne, Westinghouse and Thomson-Houston machines the periodicity is from 125 to 136.

The European practice as to the rate shows considerable variation. Messrs. Ganz & Co., of Buda Pesth, in the Zipernowsky system use 42 cycles; Mr. Ferranti uses 68; Lowrie-Parker work their machines at 80, and Mr. Mordey runs his at 100.

CONVERTERS.

Westinghouse Converter.

The Westinghouse converter is of the shell type. In the 40-light converter, the core is built up of plates ·017-inch thick, of which the total weight is 81 lbs. The primary winding of No. 16 wire weighs 10½ lbs., and the secondary wire is No. 3 gauge, 13¼ lbs. in weight. At 50 volts and 40 ampères this converter gives an output of 19·09 watts per lb. of active material. The P.D. required between primary terminals is 1,000 volts, developing an E.M.F. of 50 volts at the terminals of the secondary coil.

Recent tests by Dr. Louis Duncan, of John Hopkins University, show 95 per cent. efficiency in a 40-light converter at full load, and only 84 watts loss with no load, and 90, 87·6, 83·3, and 70·7 per cent. efficiency in a 20-light converter at full, three-quarter, half and quarter loads respectively.

Brush Converter.

The Brush converters are of the core pattern, with the exception of the two of smallest size. The iron wire in the core of the 50-light converter weighs 92 lbs., the primary wire weighs 20 lbs., and the secondary winding 11 lbs. At 100 volts and 30 ampères its output is thus 24·39 watts per lb. of active material. The case weighs 100 lbs. The 75-light converter core of iron wire weighs 115 lbs., primary winding of copper wire 21 lbs., and secondary winding 15 lbs. At 100 volts and 45 ampères the output is 29·8 watts per lb. of active material. The case weighs 110 lbs. These converters are made in standard sizes of 5, 10, 20, 30, 40, 50, 75, 125, 250 lights, and up to 1,000 lights capacity. They are also made for primary circuits of 1,000 volts pressure, with a ratio of conversion of 10 to 1 or 20 to 1. The core consists of the finest Swedish iron wire, insulated by cotton winding or braiding wound into an octagon form, by having pieces of wood placed under and through the coils, as shown. The secondary wires are then wound over the sections between the wood blocks with insulated pads between them and the iron wire at the corners. Over the corners of the secondary winding are placed other insulating pads, over which are then wound the fine primary wires. There is thus an air space for insulation all round the different coils, except at the corners where the wires lie on the insulating pads. The efficiency of a 75-light converter varies from 98 per cent., with 75 lights attached, to 93 per cent., with 38 lights.

THOMSON CONVERTER.

The Thomson converter, manufactured by the Royal Electric Company in this city, is similar in construction to the Westinghouse. The following are the particulars of the 30-light size:—Iron discs, 108 lbs.; primary wire, 920 feet No. 18 B. & S. gauge, 4¾ lbs.; secondary wire, 44 feet No. 8 B. & S. gauge, two in parallel, 4 lbs.; total active material, 116¾ lbs., with an output of 13·20 watts per lb.; case, 59½ lbs.; weight complete, 176 lbs.

METERS.

Edison Meter.

In the Edison system of distribution an electrolytic meter has been employed. A disadvantage connected with its use is that nobody except an *employé* of the company can find out what the meter has registered, and even he has to take every precaution in the washing and drying of the electrodes, and in their accurate weighing in a chemical balance. This meter has been very extensively used, and has evidently given fair satisfaction, but statements from some of the superintendents of Edison stations show satisfaction is not general.

Sir D. Salomons, in the last edition of his work on electric lighting, describes the Edison meter as a thing of the past.

It is but fair to the Edison Company to say that they do not recommend their meters being used in stations of less than 1,000 lights capacity.

Aron Meter.

The Aron three-wire meter is used in all the large Edison stations, and by some other companies in Germany. It is a most admirable and reliable instrument, and it is one from which the consumer himself can learn what he is using. The registering apparatus consists of two sets of clockwork, which will run 40 days with one winding, but which it is intended to wind up every 30 days, when the readings are taken. The pendulum on the left is an ordinary pendulum, uninfluenced by the current; but that on the right consists of a coil of very fine wire, which is connected direct to both the positive and negative wires of the system, while one of the main wires, either the positive or negative, forms a solenoid through which the main current passes, enveloping the fine wire pendulum core.

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* Abstract of paper read May 8th, 1890, before the Canadian Society of the Civil Engineers.

Before any current is passed through the meter, it should be tested in place to see that the pendulums swing synchronously. If they do not, the indications of one pendulum will gain upon those of the other. The exact adjustment to perfect synchronism is obtained by raising or lowering the weight on the left hand pendulum. If found correct the current is passed through the meter, and the right hand pendulum's movement being accelerated by the action of the current, causes the registering gear to work.

The chief obstacle in the way of the more general employment of this meter is its comparatively high first cost, but it appears to be well worth the money.

Shallenberger Meter.

The Shallenberger meter is the one which has been most extensively used in America for the measurement of alternating currents, having been exclusively used in the Westinghouse stations, and being now largely used in those of other companies. About 12,000 are now in use. It is simply a small alternating current motor with registering gearing, and attached vanes placed on the shaft to retard the movement to a degree necessary for adjustment and regulation. Its chief disadvantage is that it does not work readily with a small current, but as this tells against the company and not against the consumer, the latter will probably not have any objection to it.

STORAGE BATTERIES.

Storage batteries have not been applied on this continent to any such extent as they have been in Europe. Wherever they are employed, except for propulsion of about a dozen street railway cars, perhaps fewer, it has been for the purpose of securing light after engines and dynamos have been stopped at night, and for railway car lighting. For the latter purpose they have not hitherto been a success, and have been discontinued on the Pennsylvania Road, on the Canadian Atlantic, and on the Grand Trunk Railways, the Julien battery having been used in these cases. On the Intercolonial Railway a great number of cars have been fitted up with these batteries, and it is said several additional charging stations are to be erected, it having been found that the two at present in operation, one at Levis and the other at Moncton, together with such current as may be obtained at Halifax, N.S., and Montreal, have been insufficient, or otherwise expressed, the capacity of the batteries supplied has not been enough to last during the runs between the various stations. The fact that the coal oil lamps, which were wisely left in position, are used on nearly every trip, proves the inadequateness of the batteries which have been supplied for this work.

Outside of these plants storage batteries have been used in five or six places in Canada, among which may be mentioned McGill College, the lights which we have here being run from a Gibson battery in the basement. The battery is charged from a small shunt wound dynamo, driven by an Otto gas engine made by Crossley Bros., of Manchester.

VALLEYFIELD AND BARRIE CENTRAL STATIONS.

Let us describe briefly and compare these central stations, both constructed by the writer, and good samples of their respective classes. Both have water power, but the first is on the Edison three wire system, and the second is a Brush A. C. plant. In Valleyfield the power is in the heart of the town and in the centre of distribution, so that it is in the most favourable position for economical distribution by low tension, and the wire used is as small in area as consistent with even voltage at the lamps and best efficiency of the plant. Both stations were built with rooms for the man in charge over the dynamo room. The running expenses are the same or about the same in both places. Probably no other stations of similar capacity in the world cost less to run, the total annual expense in each being less than $1,600. The capacity of both stations is about the same, say 60,000 watts. The Valleyfield station complete cost $40,000, including building, water-wheels and flume. The Barrie station, with the same items, cost less than $22,000, including over $3,000 for the wire leading into town from the station, five miles distant. In the Barrie plant heavily insulated wire is used throughout the 24 miles of street wiring, and rubber covered wire in all buildings, whereas bare wire is used at Valleyfield for street wiring, and fire and weatherproof wire for inside work. House wiring in Valleyfield is all cleat work; most of that at Barrie is concealed, the lights in the latter place being principally in private houses, and placed on brass fixtures, whilst at Valleyfield drop cords are used exclusively. The pressure in the houses in Valleyfield is generally 220 volts, the three wires being carried in in all cases where this system is used, in order to maintain as even a load as possible on both sides of the circuit. In Barrie the pressure is 93 volts on the lamps in the houses, and nothing higher than 98 volts can ever enter them. The charge for current averages at Valleyfield $9 per light a year, and at Barrie $7.50. This means that, making due allowance for all contingencies in both cases, the Barrie plant will pay its shareholders better than the Valleyfield plant will, while the customers pay $1.50 per light a year less. In the Barrie station Westinghouse meters are used on the premises of the largest consumers, and these can be read by the consumer as well as the meter man, the cost of operating the station is not increased, the man who attends to the wiring of the buildings in town and to collection of accounts taking the readings; while, if the Edison meter be used at Valleyfield, another man will require to be employed to attend to the meters solely, and his wages will have to be added to the operating expense and thus reduce the net revenue.

The respective sizes of wire used in both stations is worthy of study. At Barrie the loss in the feeder is 14½ per cent. at full load, nearly the same as at Valleyfield. The length of feeder at Barrie is 10 miles for the complete circuit, and the size of wire No. 4 B.W.G. At Valleyfield the feeders are three in number and three in a set; the longest is less than two miles for the complete circuit, and the size of the outside wires No. 000 B.W.G. The No. 4. wire used at Barrie weighs 985 lbs. per mile, including insulation, and the No. 000 bare wire at Valleyfield weighs 2,886 lbs. per mile.

It may be and has been said that in the one case you have a perfectly safe low tension system, while in the other, to use the pet phrase of the paid advocate of low tension, the New York State electric executioner, you have the "deadly alternating current." That is admirable as a trade trick, but even the Edison Company now advertise that they are prepared to supply A. C. plant to all who desire it. Either there is less danger in the A. C. system than they would have the public believe, or they are ready to subordinate principle to pocket in the contest. To alter slightly a phrase from Dickens's "Holiday Romance," the Edison people have been advising the public to "prohibit the use of the alternating current system on the ground of humanity, as it makes ours too expensive." In an article on the subject, Sir William Thomson, the greatest living authority on electrical matters, says :—

> *"In passing, I may remark that* 100 *volts in the house is perfectly safe to the user, whether the current be alternating or continuous, as is proved by large and varied experience in England."*

It must be freely admitted that the accidents reported from New York were real and not invented for sensational purposes, but it must also be acknowledged that in no other city in the world is there such an organisation as the Board of Electrical Control, to which appointments are made by political influence only, regardless of qualification, and one of whose advisers is, or was, an individual whose business it was for the past two years to discredit the alternating system, for which service he was well paid. In no other city in the States or Canada is there such bad construction of overhead conductors as there was in New York, and the underground construction there is nearly as dangerous on account of existing grounds on the wires and leakage of current, and the consequent liability to cause explosions of gas in subways, as has already been repeatedly done, besides turning the paving stones into "a molten mass."

Furthermore, the insulation of the overhead wires, which have been in use in some cases over eight years, had rotted off, being of the quality known as "Underwriters," or "Undertakers," if you will.

Four deaths have occurred in the whole history of electric lighting in Canada from shocks of electricity, and two of these were the result of bad insulation of wires and faulty construction by a purchasing company doing its own work, without employing anybody having any knowledge of the business, in order to cheapen the first cost of the plant, and which purchased a job lot of poorly insulated wire, and ran two dynamos in series with 100 arc lamps in circuit at a tension of nearly 5,000 volts. The current used on that system was a continuous one, not a pulsating high tension current, as stated in a circular which some of you may have received.

Reverting to our main subject. Thirty wires radiate from the Valley field station; one pair carry the current from the Barrie station. In the Barrie station the pressure of primary current is the highest which has yet been used in this country, being about 2,100 volts average on the feeder. This pressure is raised or lowered by increasing or decreasing the exciting current according to the load shown on the central station ammeter, which is graduated to single ampères, and is indicated by a Cardew voltmeter, which, as elsewhere mentioned, is attached through a converter to the armature. Instead of having a compensator, as is used in the Westinghouse system, a table of loads and the corresponding pressures to be carried at the station is used. This method, though of course not absolutely perfect, owing to the rise of current with increase of voltage and *vice versâ*, answers very well. The Cardew voltmeter in the company's office in town, which is an excellent check upon the dynamo attendant's work, shows an average variation of two volts only in a night's run. The mains in town, which aggregate nearly 14 miles in length, are calculated for a loss of only 2 per cent. at full load, which gives a difference of two-thirds of a volt per lamp up or down from the standard. The house wires, which are insulated with rubber and tape, are calculated for 1 per cent. loss only at full load. As most of the lights are taken in private residences, where the whole number are hardly if ever in use at one time, the loss of light through resistance of the house wiring is practically nil.

MEASURING IESTRUMENTS.

The Ayrton and Perry instruments have been used to a very considerable extent in this country, and until recently were the most accurate of all really portable electrical measuring instruments. There is a sample on the table before you. They are only suited for direct currents, and are open to the objection that they have considerable friction and a high temperature error if kept in circuit, which they should never be except only for a few seconds when taking readings.

The Weston voltmeter has the great advantage of extreme accuracy and very high resistance, averaging about 20,000 ohms, so that the quantity of current passing is extremely small. They may be kept continuously in circuit without any material variation in their readings. They require careful handling, of course, as do all electrical instruments, but they are the most accurate and reliable of all portable testing instruments for continuous currents. The voltmeters contain a calibrating coil by which their constancy can be at all times tested. The writer has used quite a number of these instruments, which he has checked with each other, and has sometimes compared the higher and lower scale by taking the P.D. difference between terminals of single cells of secondary batteries, and then, putting the whole of the cells in series, compared the reading of total E.M.F. of the battery. Several tests of this nature have come out within one quarter of a volt. The calibrations are in single volts on the higher scale, and thirtieths, twentieths, or tenths of volts on the lower scale. The ammeters read to tenths of ampères in the small sizes. In both the divisions of the scale are so wide that one-quarter of these values can be read with perfect ease.

For the most perfect readings by these instruments they should be set quite level, and five feet away from any other instrument, or from any mass of iron or steel, and so placed that the index will point due west when at the centre of the scale, but these precautions are not necessary for ordinary testing of pressure in buildings, as the error can seldom be more than half volt if otherwise placed.

The Cardew voltmeter is used for both direct and alternating currents, and is made to be used either vertically or horizontally.

The horizontal pattern has the advantage of being steadier than the vertical instrument, owing to the disturbance caused by currents of air passing up the tube of the latter. All the more recent forms of this instrument have an adjusting screw outside of the case to bring the needle to zero, which should be done before the current is turned on. No adjustment should be made while the wire remains warm, as the section of the wire may be altered by any tension put upon it while in this condition and the calibration destroyed.

For alternating and direct currents Sir Wm. Thomson's latest instruments are the finest yet produced, but are more suited for standard or station use than as testing instruments. In the electrostatic instruments no current passes through the instrument at all, and so the conditions of a battery or dynamo on open circuit can be found with perfect accuracy. The electrical balances are adapted for both alternating and direct currents. To anybody desiring a fine standard laboratory or station set of large range, none are better than these instruments, expensive though they be. All stations for alternating current work should have a Cardew or Thomson voltmeter, a portable Thomson multicellular electrostatic voltmeter for testing pressure in consumer's premises, &c., and a Thomson ampère gauge. For direct current stations Weston or Cardew voltmeters for station work and line testing should be used, and Thomson ampère gauges for current measurement.

TRANSMISSION OF POWER.

In his address at the annual meeting, the President touched upon the subject of electrical transmission of power, mentioning the installation at the Chollar Mine, Virginia City, Nevada. There a Brush plant is used, as then stated, placed 1,680 feet below the surface of the ground, in a chamber 50 feet long by 25 feet wide by 12 feet high, hewn out of solid porphyry. The small stream of water, which drove the wheels at the surface of the mine, was carried down through two iron pipes, one 10-inch and the other 8-inch diameter, connected together at the bottom of the shaft by a Y into a single pipe 14-inch diameter, from which 6-inch pipes lead to the Pelton water wheels' nozzles, and there develops sufficient energy through the generators to transmit to the surface by well insulated cables 450 H.P. The waste water is conveyed away through the Sutro Tunnel, pierced through the side of the mountain for the drainage of the mines—in itself a monument of engineering ability and Western enterprise. This is at present the largest installation in the world for transmission of power by stationary electric generators and motors.

About August last a generator and a motor of exactly the same type as those placed in the Chollar Mine were installed at Messrs. Barber & Co.'s Mills, Georgetown, Ont. The water of the Credit river was dammed over two miles below the mill, and a water wheel and shaft were placed in a building there along with the generator. A copper wire was carried back and attached to the motor, which develops 75 H.P. in the mill.

ELECTRIC RAILWAYS.

Four years ago there may be said to have been no electric railways in operation in America. Yet, according to the most reliable sources of information there were 636½ miles of electrically equipped railways in operation, and 700 miles under construction at the end of December, 1889; 1,063 electric cars were then running, and 771 cars were being equipped. The total number of completed roads was 107, and 85 were under construction. Of these roads two were running in Canada, their total length being 10 miles, and these were equipped with 10 motor cars. The first, at Windsor, Ont., with two miles of road and two cars, has now been at least four years in operation; the other is at St. Catharines, and the length of road is eight miles, and it is equipped with eight cars. Both roads use the Vandepoele system. The road at Victoria, B.C., is now running. The track is four miles long, with six motor cars. The Vancouver road, which is likewise four miles in length, and will be equipped with four motor cars, will be running about the beginning of June. The Thomson-Houston system is used in both cities, and a contract for a short line in Toronto, on which two motor cars will be used, has lately been closed with the Thomson-Houston Company, which has done by far the largest amount of work in electric railways, the Sprague Company ranking next. The table given below shows the amount of work done by various companies and that under construction in January last.

ELECTRIC RAILWAYS.

In operation and under construction, January, 1890.

Name of System.	In operation.		Under construction.	
	No. of Roads.	No. of Cars.	No. of Roads.	No. of Cars.
1. Thomson-Houston ...	47	490	37	509
2. Sprague	35	408	33	218
3. Daft	10	66	5	15
4. Van de Poele	8	57		
5. Short	3	17	1	5
6. Bentley-Knight	1	6	1	20
7. National Electric Traction Company ...	1	1	5	not given
8. Julien	1	10		
9. Fisher	1	4	2	not given
10. Henry	1	4		
11. Rae			1	4

Within the past few months great activity has obtained in electric railways in the United States, and the two leading companies in this business have contracted for several hundreds of cars each; the lead of the Thomson-Houston Company having increased, while the Sprague Company has over 1,200 motors cars in operation or in course of construction.

The largest electric street railway system in the world is that of the West End Railway of Boston, contracted for by the Thomson-Houston Company, of which the following particulars may be of interest:—At the present time there are 150 cars running, and when completed there will be 600 in operation. Now there are 56 miles of road electrically operated, and 236 are to be equipped. In the power station from 3.30 till 7 p.m. the electrical plant, which is capable of developing, if called upon, 2,500 H.P., usually furnishes from 1,000 to 1,500 H.P. The cars generally in use are 16 feet closed cars, each carrying 30 passengers and towing a similarly loaded car. Such a car, equipped with a single 15 H.P. motor, averages in speed 15 miles an hour on the level, and will pass a grade of 5½ per cent. at the rate of nine miles an hour. Such work is, however, rather severe for constant use, and for heavy work they are using two 15 H.P. motors. The potential used is 500 volts, and the average rate of speed is from 10 to 15 miles an hour. The weight of a motor car equipped is 6 tons. The cost of steam power is from one to four cents. per car mile, taking 100 miles per car per day as a basis; the cost of operation and maintenance, four to 6 cents per car mile on the same basis; the cost of repairs to electrical apparatus is from one and a half to two cents per car mile; cost of management from one to two cents per car mile, and the average total cost of operation is nine and a half to sixteen cents per car mile, according to the number of miles operated.

Unfortunately the severe winters and heavy snowfalls of Montreal and other cities in Eastern Canada preclude the possibility of working electric railways the whole year on our present street roads, but it is a question worthy of the study of members of this society, whether or no it would pay to operate our roads electrically during the seven months of open weather which we get, or if a system of overhead railways along our main traffic thoroughfares operated electrically, and which could be run the whole year round, would not be a good investment.

STREET WIRING FOR ELECTRIC LIGHTING.

First, on account of the dangers of breakdown from heavy sleet storms, and the variation in tension of wire caused by the extremes of temperature experienced in Canada, poles should be placed not more than 135 feet apart, or, say, 40 to the mile. They should all be good, sound, straight cedar, 7 inches diameter at the the top end and not less than 35 feet long, and should be set in the ground to a minimum depth of 6 feet and securely tamped. The cross arms should be of sound timber, 4½-inch by 3½-inch, well painted and fixed in gains cut in the poles, and secured thereto by lag screws 8 inches long, which would thus enter into the pole about 4½ inches. They should never be attached by spikes only. Wherever telephone or telegraph wires run in the same streets, the poles should be of sufficient height to carry the electric light wires at least 4 feet above them. Bare wire for carrying either high or low tension currents in town should be strictly prohibited. The insulation of the wire should be both fire-proof and weather-proof, and be of such tough texture as to withstand abrasion should other wires by any means fall across the electric light wires. None but the best double-petticoat glass insulators should be used.

For outside construction some of the English Board of Trade regulations, which might be adopted with advantage in this country are as follows, the numbers given being those of the regulations :—

1. An aerial conductor in any street shall not in any part thereof be at a less height from the ground than 20 feet, or when it crosses a street, 30 feet, or within 6 feet of any building for the purposes of supply.

2. Every support of aerial conductors shall be of durable material, and properly stayed against forces due to wind pressure, change of direction of the conductors, or unequal lengths of span, and the conductors and suspending wires (if any) must be securely attached to insulators fixed to the supports. The factor of safety shall be at least 6, and for all other parts of the structure at least 12, taking the maximum possible wind pressure at 50 lbs. per square foot.

5. Every aerial conductor shall be protected by efficient lighting protectors.

6. Where any conductor crosses a street, the angle between such conductor and the direction of the street at the place of such crossing shall not be less than 60°, and the span shall be as short as possible.

7. Where any aerial conductor is erected so as to cross any other aerial conductor, or any suspended wire used, for purposes other than the supply of energy, precautions shall be taken by the owners of such crossing conductors against the possibility of that conductor coming into contact with the other conductors or wire, or of such other conductor or wire coming into contact with such crossing conductor by breakage or otherwise.

11. The insulation resistance of any circuit using high pressure aerial conductors, including all devices for producing, consuming or measuring energy connected to such circuit, shall be such that should any part of the circuit be put to earth the leakage current shall not exceed $\frac{1}{25}$th of an ampère in the case of alternating currents. Every such circuit containing high pressure conductors shall be fitted with an indicating device which shall continuously indicate if the insulation resistance of either conductor fall below the conditions required by this regulation.

14. The owner of every aerial conductor shall be responsible for the efficiency of every support to which such conductor is attached.

15. Every aerial conductor, including its supports, and all the structural parts and electrical appliances and devices belonging to or connected with such conductors, shall be duly and efficiently supervised and maintained by and on behalf of the owners as regards both electrical and mechanical condition.

16. An aerial conductor shall not be permitted to remain erected after it has ceased to be used for the supply of energy unless the owners of such conductor intend, within a reasonable time, again to take it into use.

17. Every aerial conductor shall be placed and used with due regard to electric lines and works from time to time used, or intended to be used, for the purpose of telegraphic communication, or the currents in such electric lines and works, and every reasonable means shall be employed in the placing and use of aerial conductors to prevent injurious affection, whether by induction or otherwise, to any such electric lines or works, or the currents therein.

The author considers that rules 7, 13, 14, 15, 16 and 17 should be equally binding upon telegraph and telephone companies whose wires are often as carelessly constructed as those of any electric light company, and have in consequence been quite as blameworthy for fires originating from electric currents.

HOUSE WIRING.

In the interior wiring none but high class rubber insulated wire, protected by an outer linen tape or other efficient covering, should be used.

None but porcelain or slate base cutouts and switches should be allowed, and the sweating of drop wires for single lights on the main wires (such wires being afterwards twisted together and brought down to the lamp socket) should be prohibited.

Wherever lights are suspended by wires, stranded conductors, equal in area to No. 20 standard wire gauge, covered with a good solid rubber coating and protected on the outside by silk or cotton braiding, should be used, and where taken off from the main wires a porcelain rosette cut-out, such as the K.W. rosette, should in all cases be provided, or a wood base rosette may be used, provided it is rendered fireproof.

No switches should be used which do not break contact quickly and automatically, or in which spring copper makes a connection; such copper is heated by the passage of a large current, and, by losing its hardness therefrom often fails to make good connection, and so may cause an arc to form. The Paiste switch is the only one at present made on this continent in which these objections are successfully met.

Fuses for cut-outs should not be interchangeable with others of widely different capacity. Over-loading of wires first designed for lighter loads would then be impossible.

The joints in wires are preferably made with connectors such as the MacIntyre wire joint, as soldered joints on which acid has been used frequently corrode through the excess of acid not having been removed on completion of the soldering, and it has been the author's experience that ordinarily wiremen will not take the time or trouble to make a good joint with rosin as a flux.

It must be remembered that a low tension continuous current is more liable to cause a fire in case of short circuit between the main wires than an alternating current, owing to the connection which exists directly between the dynamo and the house wires, permitting the entrance into the house of an enormous current, while with the alternating current system the short circuiting of the secondary house wires will only result in the immediate melting of the fine wire fuse in the primary circuit of the converter. There should be no relaxation, therefore, of adopted regulations in favour of low tension direct systems on account of supposed greater safety, a thing which does not exist in their case, but both direct and alternating current systems should be treated alike so far as the wiring of consumers' premises is concerned, and the present standard should be raised, not lowered.

It should not be forgotten that one of the most important elements in the attainment of perfect safety to everybody concerned is the employment by supply companies of properly qualified and experienced labour both for the construction and for the running of plants. It will be found to be very poor economy to employ bell-hangers, plumbers and even shoemakers on work requiring considerable electrical and mechanical knowledge and clear judgment, as is done at the present time in some Canadian stations which might be mentioned, merely for the sake of saving two or three hundred dollars a year in wages, a sum which is much more than counterbalanced by the unsatisfactory results in the lighting and the additional cost of repairs. Nor should it be forgotten that a cheap and poorly constructed electric lighting plant is the worst of all possible investments.

PROCEEDINGS OF SOCIETIES.

Physical Society.—June 20th, 1890.

Prof. W. E. AYRTON, F.R.S., President, in the chair.

Mr. C. V. BOYS read a paper on "The Measurement of Electro-Magnetic Radiation," by himself, Messrs. A. E. Briscoe and W. Watson. When Mr. Gregory described his new electric radiation meter on November 1st, 1889, one of the authors said that the observed effects might be due to some cause other than expansion by heating, and that if it was a true heating effect it might be measured thermally. The present communication describes experiments undertaken to investigate the question. The first method employed was developed from the idea that if two fine wires be placed near together and both act as resonators to a primary oscillator, the electro-dynamic attraction caused by the electric currents up and down the wires and the electrostatic repulsion between the charges on them might result in the relative motion of the two wires. From theoretical considerations based on the assumptions that the currents are harmonic in time and space, the authors inferred that the electro-dynamic effect would preponderate at the middle of the wires, whilst the electrostatic repulsion would be greatest at the ends. To cause the attractions and repulsions to conspire, cranked resonators were made; one was fixed and the other suspended by a quartz fibre, to turn about a middle line. These were enclosed in a glass vessel and on starting the oscillator a turning movement was observed, in a direction opposite to that expected. This motion was eventually traced to the electrostatic influence of the oscillator for although the imperfectly conducting surface of the glass acted as a perfect screen from such action when the potentials of the oscillator were varied slowly, it did not do so for changes occurring about 500 million times per second. After adopting means to avoid this disturbance and constructing lighter resonators the experiments were repeated with negative results. From the dimensions of the quartz fibre used it was estimated that a force of 158 millionths of a grain could have been detected with certainty; this would have corresponded to about $\frac{1}{300}$th of an ampère in each resonator. It is hoped that by further increasing the sensitiveness of the apparatus and using parabolic reflectors the effect sought for may be detected.

In the second method of attacking the subject, a Joule's dynamic air thermometer was employed. This consisted of a glass tube with a partition along the middle extending nearly to the ends. If one side of the tube be warmed, convection currents circulate and deflect an index placed in the stream. A small mirror suspended about one edge and counterpoised, was used for an index and was so sensitive that it was impossible to get the air still enough by any ordinary method of screening. However, by the ingenious device of putting the thermometer within a larger tube kept rotating by clockwork, the difficulties were surmounted. A doubled wire, placed in one side of the thermometer, served as resonator, and on starting the oscillator a large deflection resulted. A similar deflection was caused by applying about one-third of a volt to the ends of the wire. This proved that the effect observed by Mr. Gregory is due to heating. The least rate of heating observable with the air thermometer was found to correspond to one calorie (gramme-water-centigrade) per 24 hours in the whole tube, or one calorie per centimetre of wire in 103 days.

Dr. LODGE asked Sir William Thomson whether, when electric pulses travel along parallel wires with the velocity of light, any action could exist between them, for two charged spheres travelling together at that velocity exert no mutual attraction or repulsion.

In reply, Sir William said he was inclined to think Mr. Boys's treatment of the subject was in the main correct, but it was quite possible that at such velocities the ordinary laws might be modified by the fact that the time taken for the force to be propagated from wire to wire is comparable with that required for the pulse to travel the whole length of the wire. As an example of the peculiar effects of rapid discharges, he said he had seen two copper wires which had been flattened against each other by lightning.

Mr. Boys thought that in his resonators a condition analogous to stationary waves would exist, for the pulses are reflected from the ends.

Dr. Lodge said he had that afternoon observed the action of parallel strips when Leyden jar discharges were passed through them. The strips gave a kick at each discharge.

Mr. Gregory mentioned that in trying to increase the sensitiveness of his meter so as to measure the variation with distance, he had found that two resonators in proximity interfered with each other. He had, however, succeeded in increasing the sensibility about five-fold.

Prof. Worthington asked if it was possible to measure the energy of the oscillator, and also whether the quantity caught by the resonator could be estimated from the solid angle it subtended at the source of energy, wherever that might be.

Prof. Perry considered it easier to infer the energy of the source from that received by the resonator.

Dr. Lodge said the energy of the source could be easily measured. The power radiated was enormous whilst it lasted, vastly exceeding that of tropical sunshine; if it could be made continuous the apparatus would soon be red hot. The energy radiated, he said, converges on the resonators and hence the solid angle method of estimating the amount received would be erroneous. Moreover, the source was not at the oscillator, but at a quarter wave length from it, and most of the energy returns to the oscillator; only a small fraction is splashed off and sent into space. Small oscillators radiate powerfully because the quarter wave lengths are small, whereas the slow oscillators or alternators used commercially radiate very little of their energy. The exact law of variation of intensity of radiation with distance was rather complicated, but the theory had been completely worked out by Stokes in 1848.

Mr. Blakesley thought the energy that returns to the oscillator would be available for subsequent radiations.

Dr. Lodge pointed out that wires or other resonators placed within the quarter wave length would intercept part of the returning energy.

Two communications, "Notes on Secondary Batteries," by Dr. Gladstone and Mr. Hibbert, and "An Easy Rule for Calculating approximately the Self-induction of a Coil," by Prof. J. Perry, were taken as read.

In the first of these, the authors show cause for believing that the beneficial effect produced by adding sodium sulphate to the ordinary electrolyte is due to its power to diminish local action between the electrolyte and different parts of the lead plates. As regards the chemical actions which take place during the working of ordinary cells, they see no reason to doubt the view put forward by one of them in 1882, that the substance produced in the voltaic reaction is ordinary lead sulphate $Pb\ SO_4$. They also conclude that the high E.M.F. of a cell immediately after stopping the charging current is due to the inequality of acid strength near the two plates, and theg radual fall of E.M.F. is caused by the equalisation of strength produced by diffusion.

Prof. Perry's rule relates to hollow cylindrical coils, and is expressed by the following formula:—

$$\text{L (in secohms)} = \frac{n^2 a^2 \div 10^7}{1{\cdot}844\, a + 3{\cdot}1\, c + 3{\cdot}5\, b}$$

where
n = number of windings,
a = mean radius of winding in centimetres,
b = axial length,
c = radial depth of winding,

and b and c are less than $\frac{a}{2}$.

The time constant of such a coil is given in terms of the volume of copper (v′) in cubic centimetres by

$$\frac{\text{L}}{\text{R}} = \frac{\text{v}' \div 1{,}000}{{\cdot}728\, a + 1{\cdot}33\, c + 1{\cdot}5\, b}$$

and the conditions for making this small are pointed out in the paper.

A paper by the Rev. T. Pelham Dale was postponed till next meeting.

Royal Society.

"Contributions to the Molecular Theory of Induced Magnetism." By J. A. Ewing, F.R.S., Professor of Engineering in University College, Dundee. (Abstract of paper read June 19th).

After referring to the discussion by Maxwell of Weber's theory, which ascribes the magnetisation of iron and other magnetic metals to the turning towards one direction of molecules which are already permanent magnets, and to suggestions by Profs. Wiedemann and Hughes, and lately by Mr. A. E. Kennelly (the *Electrician*, June 6th and 13th of 1890), the writer describes experiments which he has made bearing directly on the molecular theory. The experiments have been made by grouping near to one another a large number of small pivotted magnets each free to turn about a fixed centre, and studying the configuration which the group assumes and the manner in which it yields when an external magnetic force is imposed. The results do not support the idea that the molecular magnets form closed chains in unmagnetised iron. They lead, however, to the important conclusion that no arbitrary conditions of directional constraint need be postulated to make the behaviour of the molecular magnets agree with what is known about magnetic quality.

In the writer's view the molecular magnets are perfectly free to turn in response to external magnetic forces, except in so far as they are constrained by the magnetic forces which they mutually exert on one another. This theory is briefly discussed in the paper in relation to the form of the magnetisation curve, to the character of cyclical processes, and to the known effects of temperature, vibration, stress and so forth, and the following conclusions are stated:—

1. That in considering the magnetisation of iron and other magnetic metals to be caused by the turning of permanent molecular magnets, we may look simply to the magnetic forces which the molecular magnets exert on one another as the cause of their directional stability. There is no need to suppose the existence of any quasi-elastic directing force or of any quasi-frictional resistance to rotation.
2. That the intermolecular magnetic forces are sufficient to account for all the general characteristics of the process of magnetisation, including the variations of susceptibility which occur as the magnetising force is increased.
3. That the intermolecular magnetic forces are equally competent to account for the known facts of retentiveness and coercive force, and the characteristics of cyclic magnetic processes.
4. That magnetic hysteresis and the dissipation of energy which hysteresis involves are due to molecular instability resulting from intermolecular magnetic actions, and are not due to anything in the nature of frictional resistance to the rotation of the molecular magnets.
5. That this theory is wide enough to admit explanation of the differences in magnetic quality which are shown by different substances, or by the same substance in different states.
6. That it accounts in a general way for the known effects of vibration, of temperature and of stress, upon magnetic quality.
7. That, in particular, it accounts for the known fact that there is hysteresis in the relation of magnetism to stress.
8. That it further explains why there is, in magnetic metals, hysteresis in physical quality generally with respect to stress, apart from the existence of magnetisation.
9. That, in consequence, any not very small cycle of stress occurring in a magnetic metal involves dissipation of energy.

NEW PATENTS—1890.

9263. "Improvements in electric cut-outs and switches or other circuit breakers." J. Drummond. (Communicated by R. O. G. Drummond and D. A. Bremner, South Africa.) Dated June 16.

9274. "Utilising the waste or other water power of rivers, canals, tides, &c., for electrical or other purposes, by constructing or erecting lock, shute, or other weirs with hollow iron piers and foundations or casings upon iron screw or ordinary piles, and filling with concrete, &c., to carry water wheels or encased dynamo water wheels of any kind, or by floating dynamos on such dynamo water wheels." P. H. Williams. Dated June 16.

9275. "Constructing water wheels of any form, and providing or utilising space in the interior for enclosing or attaching dynamos of any kind, or attaching encased dynamos to water wheels of any kind, or to their spindles or shafts, or floating dynamos." P. H. Williams. Dated June 16.

9343. "A new and improved flexible-jointed pipe for fluids, gases, &c., and for insulation of electric or other wires." R. M. Hague. Dated June 17.

9357. "Improvements in switches for electric glow lamps." A. Barker. Dated June 17.

9361. "Improvements in electric reduction of metals, and in apparatus therefor." T. L. Willson. Dated July 17.

9395. "Improvements in electrical apparatus for the production of rotary motion." O. Romanze, of and on behalf of the firm of Romanze and Weise, and F. W. White. Dated June 17.

9602. "Improvements in the distribution of electrical energy." Siemens Brothers & Co. (Communicated by Siemens and Halske, Germany.) Dated June 20.

9668. "Improvements in elevating and lowering electric lights." J. P. Hebendahl, G. Miller and E. F. Warner. Dated June 21. (*Complete.*)

9683. "Improvements in electrically driven percussive tools, and in the means of operating the same." L. B. Atkinson. Dated June 21.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1889

3424. "Improvements in dynamo-electric machines and motors." J. SWINBURNE. Dated February 26. 8d. Claims:—A generator or motor for direct currents, having: 1. A reversing armature core with the commutator connections embedded in it. 2. A reversing armature with the commutator connections thin where they pass through the reversing field. 3. A reversing armature core with each commutator connection passing over the outside only once, substantially as set forth. 4. Reversing magnets adjustable as to position, substantially as described. A synchronising alternating current motor: 5. In which the current-turns on the field magnets are decreased when the load increases. 6. Excited from its own armature. 7. A self-exciting alternating generator or motor, with two or more exciting coils on the armature giving currents differing in phase, substantially as and for the purposes set forth.

3671. "Improvements in or relating to winding and synchronising clocks by electricity." A. J. BOULT. (A communication from R. J. Pouchard, of Paris.) Dated March 1. 8d. The object of the present invention is to design mechanism by means of which clocks driven by weights can be wound up and synchronised or regulated electrically by passing an electric current every 24 hours over a special wire or an ordinary telegraph line. 7 claims.

4846. "Improvements in electric light fitings and Conductors." C. K. FALKENSTEIN, E. ROUSSEAU, and C. K. FALKENSTEIN. Dated March 20. 6d. Claim:—An insulated conductor for two or more wires, consisting of a core having grooves, in which the wires are laid, and a tube covering the core and wires.

5676. "Improvements in electric bells." D. REID and J. KEAN. Dated April 3. 8d. The inventors employ a relay connected to the battery and bell, and they use the same battery for actuating both the relay and the bell; one terminal of the coil of the relay is connected to one pole of the battery direct, and the other terminal of the coil of the relay is connected to the other pole of the battery through the bell-push, or other contact maker, which may be at a considerable distance from the bell. One pole of the battery is also connected to the armature of the relay, while the other pole of the battery is connected through the circuit of the bell to a stop of the armature. 1 claim.

5768. "Improvements in wooden casings for electrical conductors." W. G. DE FORGES GARLAND. Dated April 4. 6d. Claim:—A wooden casing or protective covering for electrical conductors, adapted for being readily fixed in position without risk of injury to the insulation, substantially as described with reference to the drawings; the same comprising a grooved fixed part and a removable covering piece (or pieces), suitable for being applied laterally to the said fixed part, and for engaging therewith.

7023. "Improvements in electric meters." R. SNOWDON. Dated April 27. 1s. 1d. Relates to that type of electric meters known as "motor meters," and the improvements consist in the construction of the meter in such a manner that the motion of the motor is retarded or resisted by a viscous fluid resistance, and so also that the current or currents passing through the armature of the meter is, or are, exclusively the current or parts of the current to be measured, as and for the purposes described. 12 claims.

7127. "Improvements in or connected with the brush contacts of electric railways." G. E. VAUGHAN. (Communicated from abroad by S. Trott, of Nova Scotia.) Dated April 29. 8d. Has for its objects to more effectually insulate the conductors connected with the contact brushes, to protect them from injury, and to provide an efficient carrier for the conductors and contact brushes. 3 claims.

7198. "Improvements in the manufacture of electric arc carbons." W. E. ADENEY and L. SAUNDERSON. Dated April 30. 4d. Powdered gas coke is mixed with powdered coal in the proportion of coke varying from 80 to 50 per cent., and that of coal varying from 20 to 50 per cent. To this mixture is added 1 to 10 per cent. of infusible or difficultly fusible substances such as—compounds of aluminium, silica, calcium, iron, &c., such as glass, cyanite, kaolin, bauxite, asbestos, pumice, felspar, gadolinite, samarskite, quartz, zircon, limestone, strontianite, dolomite, witherite, phosphate of lime, braunite, titanic iron, chrome iron ore, wolfram, molybdenite, fluorspar, cerite, cryolite, phosphate of aluminium, magnesite or compounds of nickel and cobalt. After careful mixing the whole is introduced into iron moulds and heated under pressure, at first gently, but finally very strongly. The carbon rod so made, if found too porous, is heated and introduced into hot coal tar, and the whole heated (preferably in vacuo) for some time. It is then taken out, and its surface cleaned, and then introduced into a mould and again heated under pressure. 5 claims.

7428. "Improvements relating to electric accumulators or secondary batteries, and to the manufacture of plates or electrodes therefor." C. POLLAK. Dated May 3. 8d. The plates are prepared by mechanically forming grooves or notches on the two sides of sheets of lead, these sheets being caused to pass between two cylinders covered with wire gauze, or carrying indented discs, or alternately full discs and indented discs, in such a manner that the grooves or notches made on either side of the plates in these rolling motions shall be of a sufficient length and depth to receive and maintain spungy lead. 5 claims.

8459. "Improvements in dynamo-electric machines and electro-motors." T. L. WILLSON. Dated May 21. 11d. Relates to a drum-shaped armature, the conductors of which consist of a single layer of longitudinal bars, with commutating brushes bearing upon these bars at one or both ends in line with the fields of force, to conduct the current to and from each bar during its passage through the magnetic field. The bars are thus cut out of the circuit as soon as they pass beyond the field, and remain with open terminals during their period of inactivity. 7 claims.

20288. "Improvements in conduits for electric conductors and combined conduits and conductors, and in the manufacture of the same." H. B. TATHAM and J. TATHAM. Dated December 17. 8d. The object of this invention is to so construct a conduit for electrical conductors that it will provide an effective insulation for the same, can be manufactured at small cost, and will be practically indestructible under ordinary conditions of use. 5 claims.

CORRESPONDENCE.

The Lineff Improved System of Electric Traction.

In your last issue I observe a note stating that a trial of the above took place on Wednesday, last week, and that a notice of the system appeared in the REVIEW of May 9th. I have compared the latter notice with those which were published by your two electrical contemporaries last week, and find that beyond a few details there is no difference, although the description in the REVIEW was given six weeks previously. It is, however, not to this that I wish to draw your particular attention, but to the trial and to the remarkable statements made by one of your contemporaries.

I am informed by one who was present at the trial, that the runs made by the open car extended over a considerable length of track—namely, about 25 *yards!* This is, indeed, a remarkable distance to make a demonstration of any system of electric traction; and yet, according to one electrical journal, "the trial seemed perfectly successful." Now, I contend, and I think with reason, that the trial was not a demonstration of the system, and that the working capability of the car was not demonstrated. To run a car to and fro 25 yards is purely a laboratory experiment, if such a phrase is admissible, and proves nothing. As far as I remember, in reading of trials of other systems of electric traction, whether third rail, "series," or accumulator, the demonstrations have been made on tracks at least one mile, and sometimes several miles long. I think, therefore, that in the case of the Lineff system a trial should have been made on a moderate length of track, and, until such is done, the system should be ignored.

Then, again, the same contemporary states that it has been informed that the "car has been run at the rate of 30 miles an hour." I should like to know where—possibly on the 25 yards track. The statement is decidedly absurd. There is not, I believe, a single electric car in the United Kingdom which has ever attained that speed. On the Barking line it is claimed that the accumulator cars have been run at 20 miles an hour, a statement which is very doubtful, considering the power of the motors, the heavy and clumsy build of the cars, and the nature of the line. Even in the United States I do not think there are any electric cars which have attained the rate of 30 miles an hour.

I am informed that the members of the Chiswick Local Board who objected to the old open slot system of Mr. Lineff, have expressed themselves as satisfied with the new method. This is interesting, considering the length of track upon which the car was run when those gentlemen were present over a fortnight ago.

There are three points upon which I should like to be enlightened. It has been found that none of the front and rear sections of the surface conducting rails are charged when the car is over any two charged sections. How will this be in rainy weather, what will be the effect when snow is on the ground, and how will the snow be removed? Moreover, the Press view last week was, I am told, arranged in an unsatisfactory manner.

F. Baines.

June 30th, 1890.

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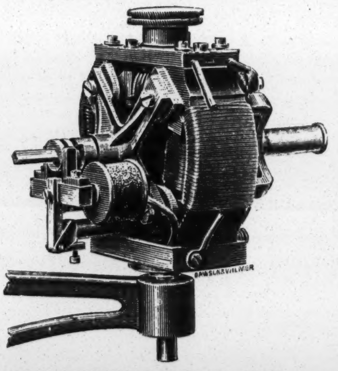

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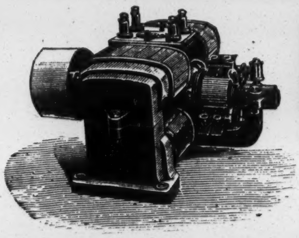

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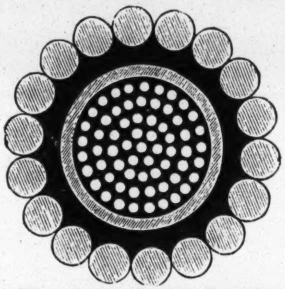

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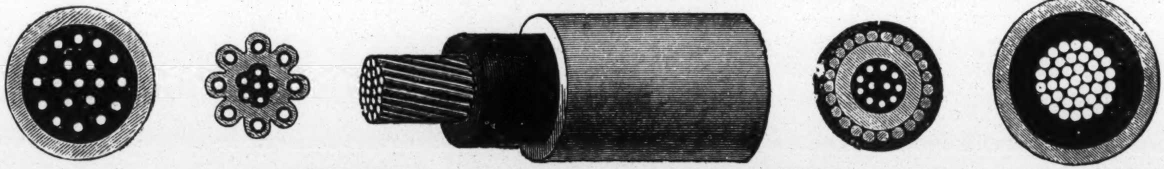

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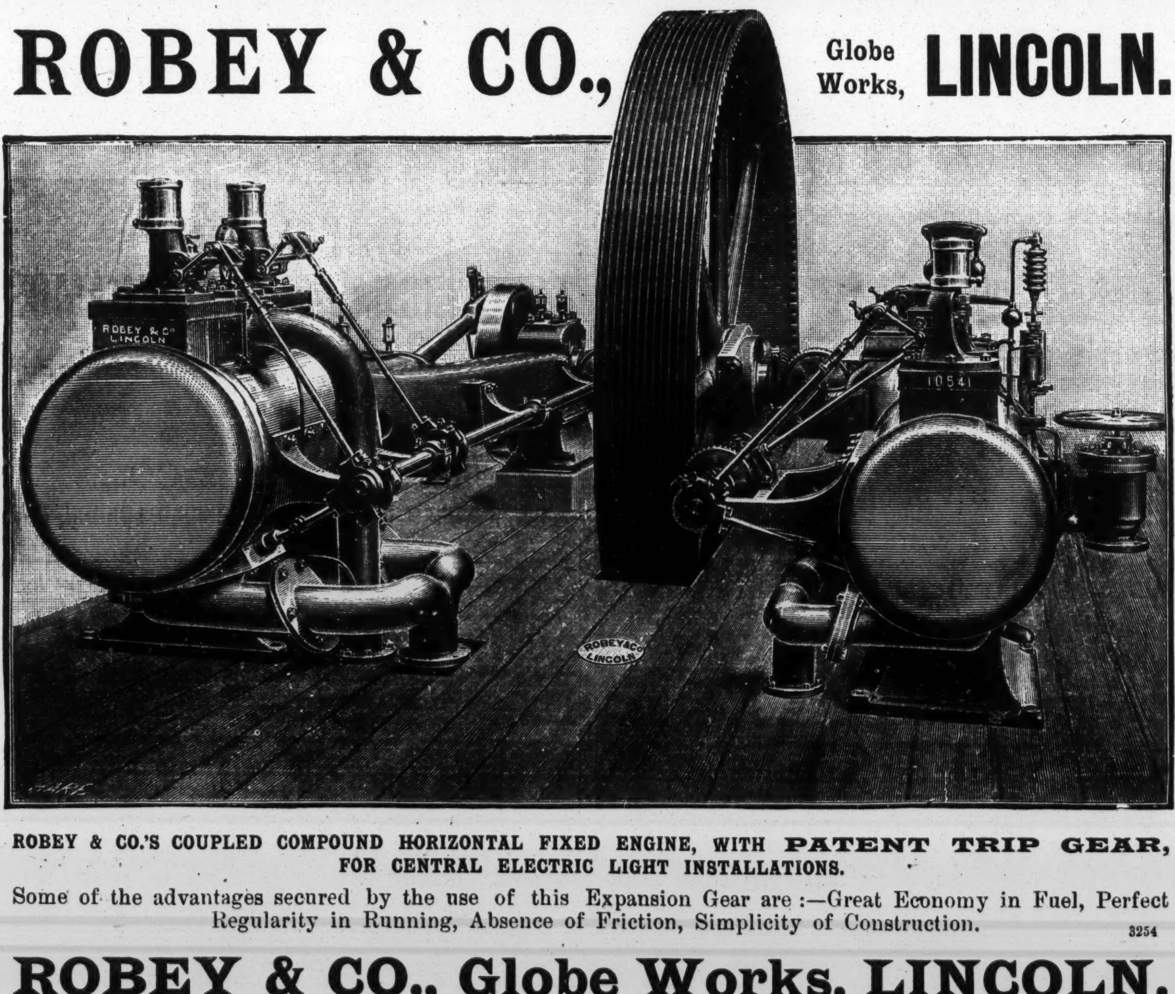

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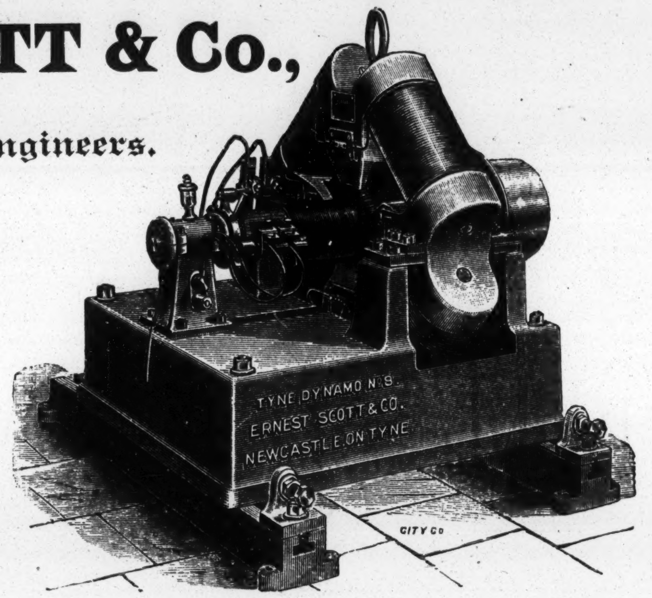

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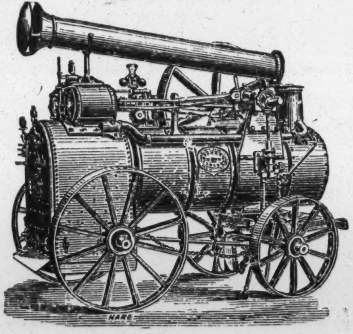
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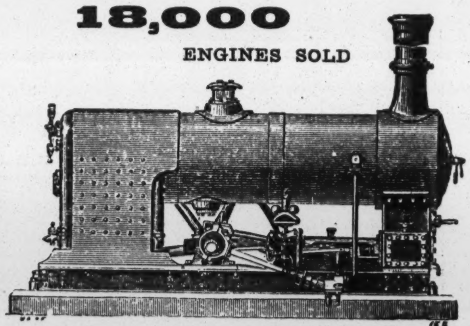
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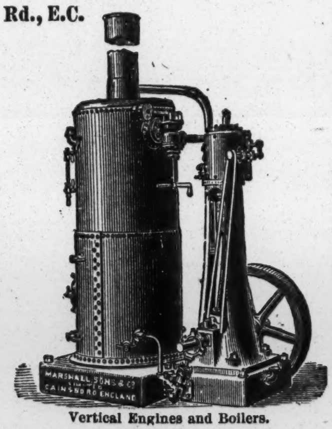

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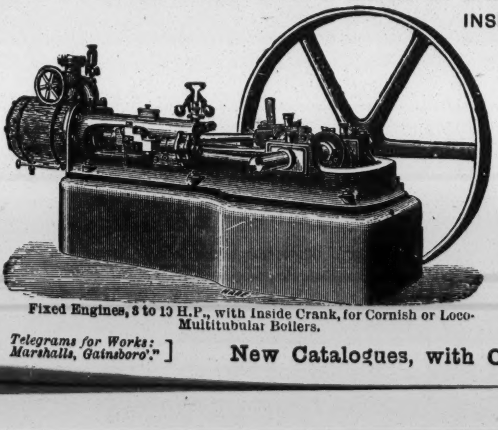
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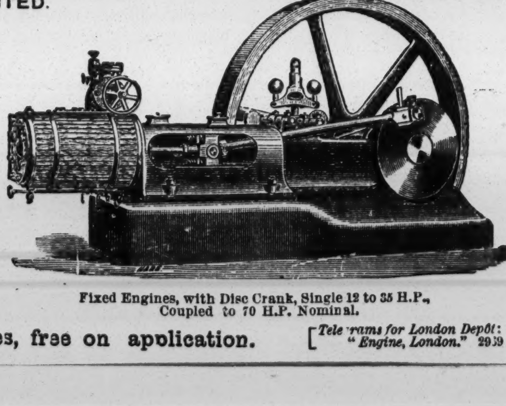
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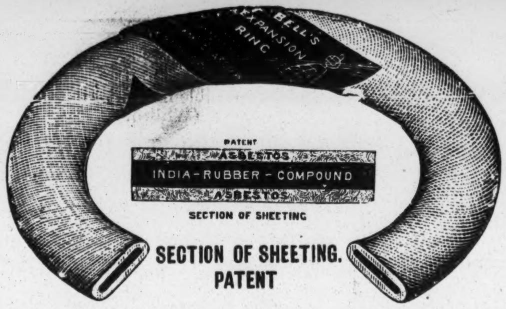

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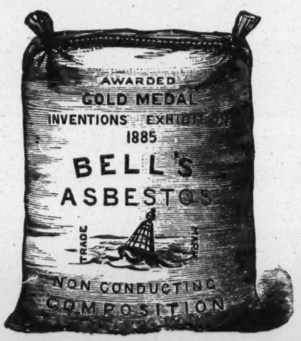

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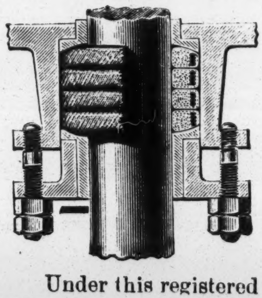

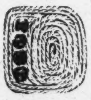

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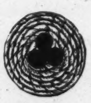

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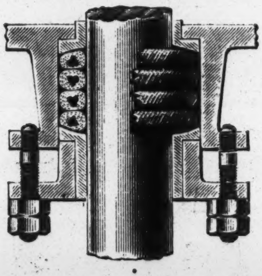

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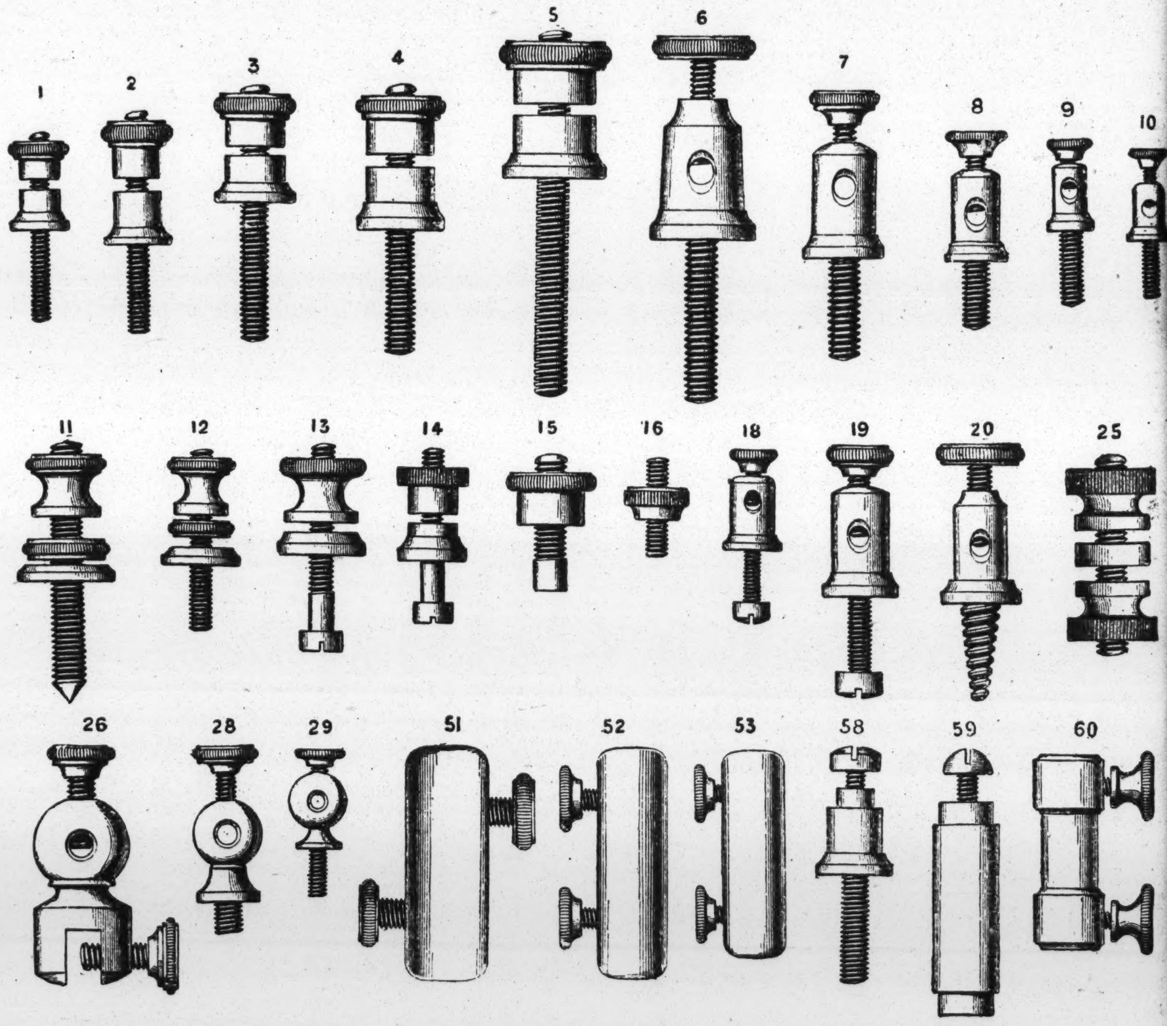

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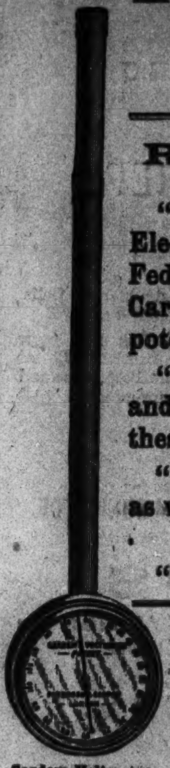

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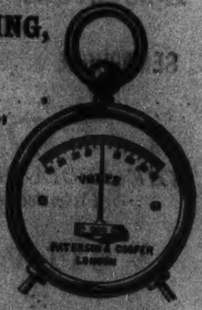

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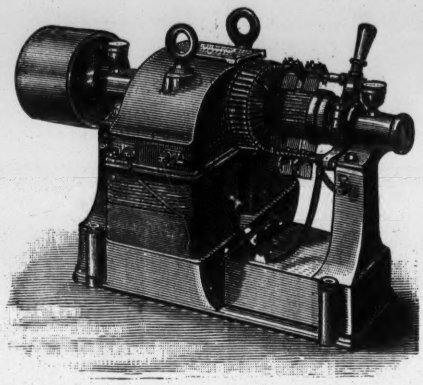

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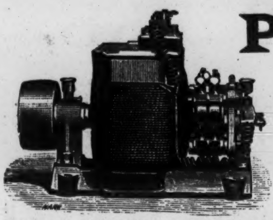

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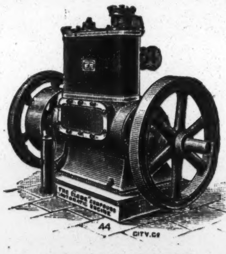

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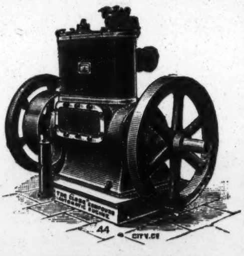

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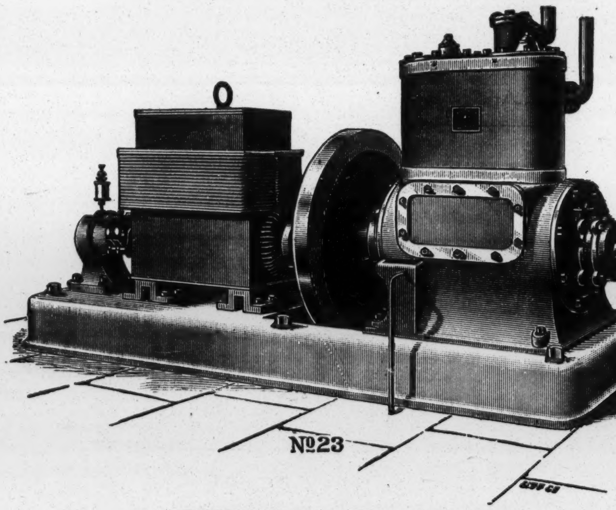

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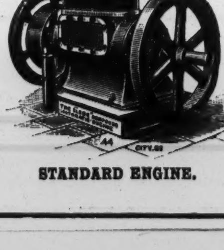

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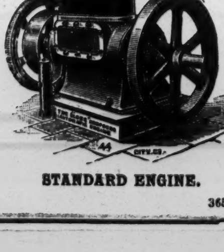

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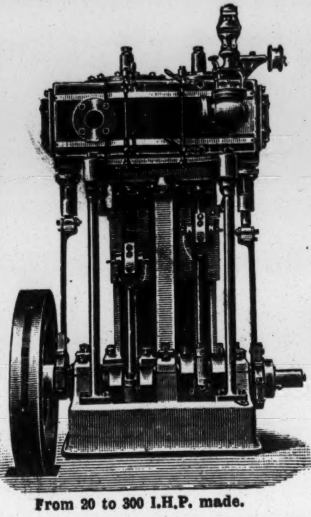

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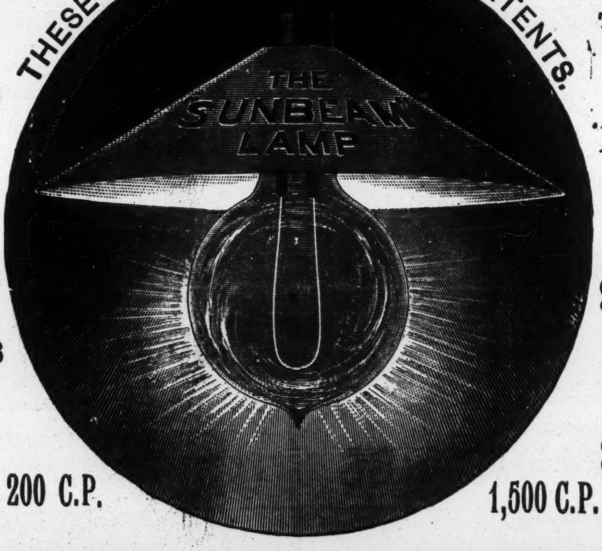

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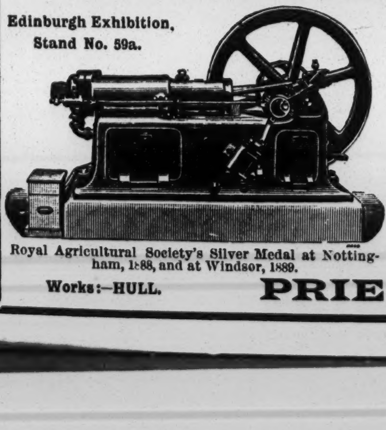

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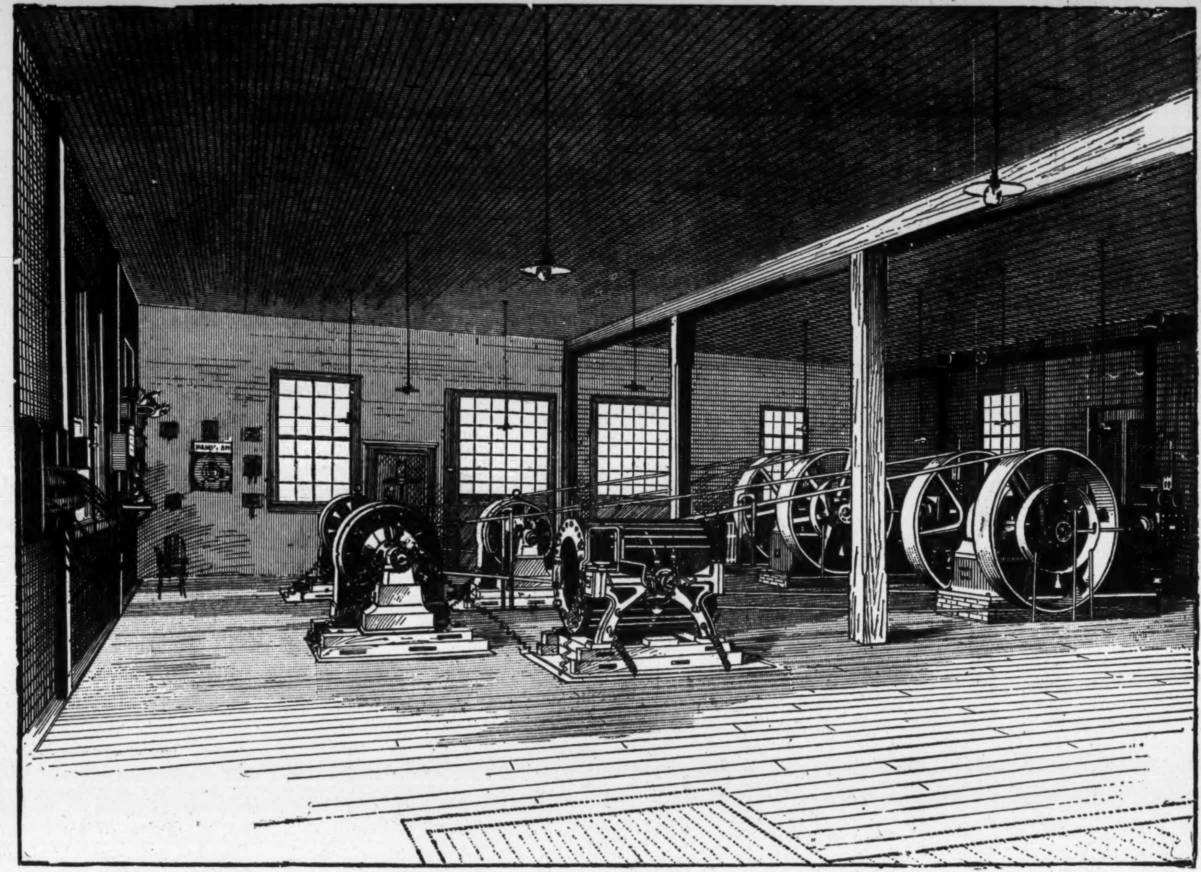

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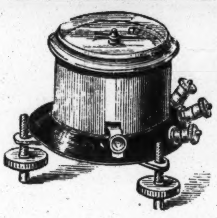

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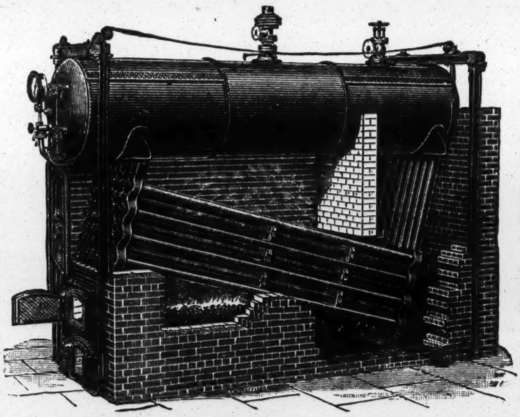

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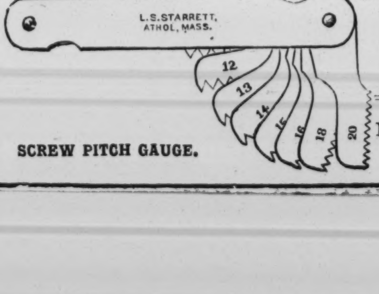

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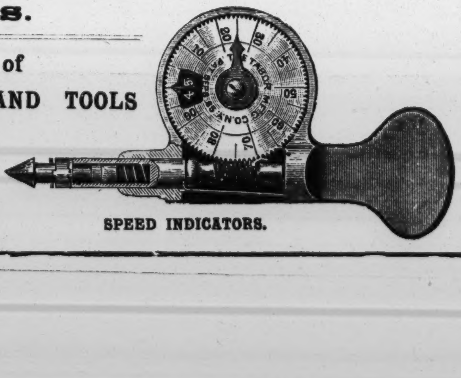

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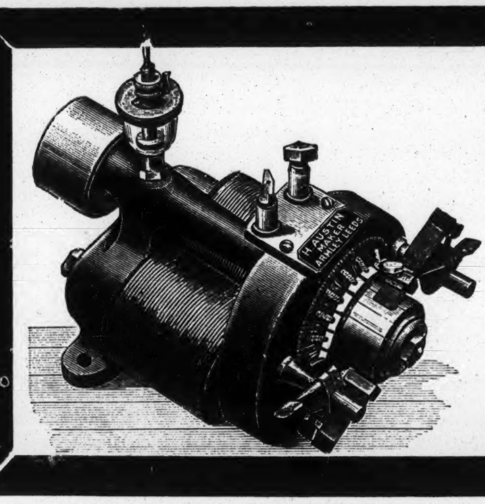

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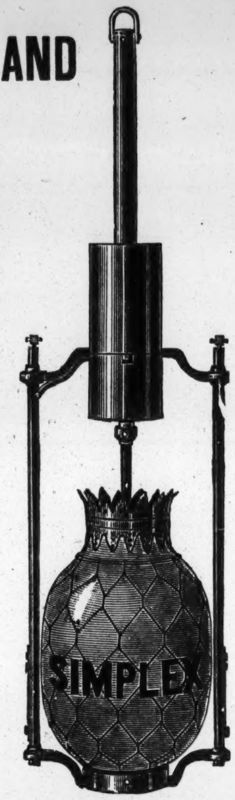

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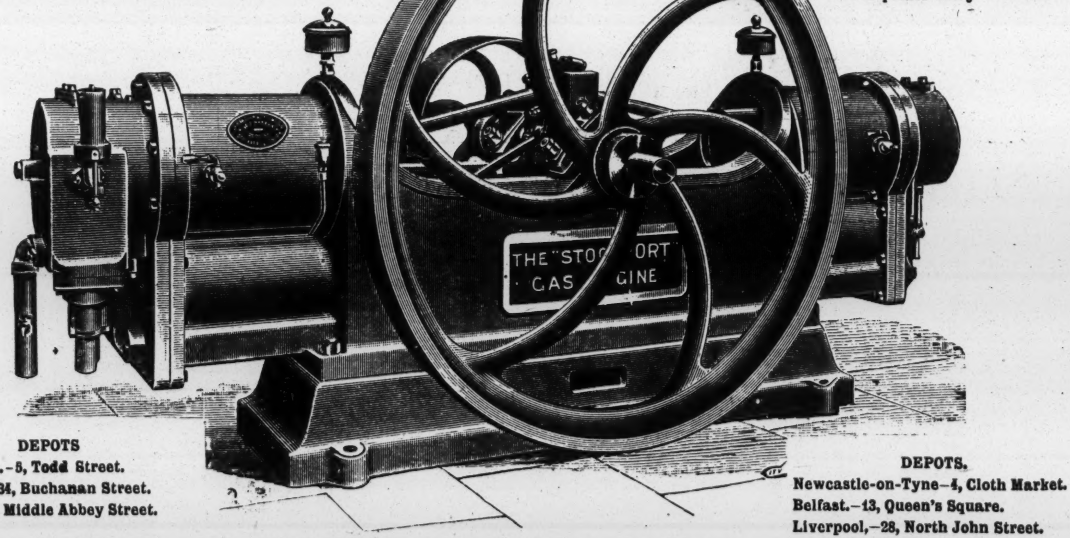

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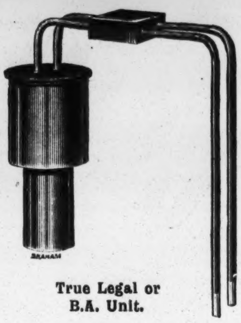

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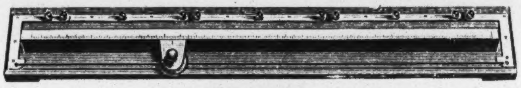

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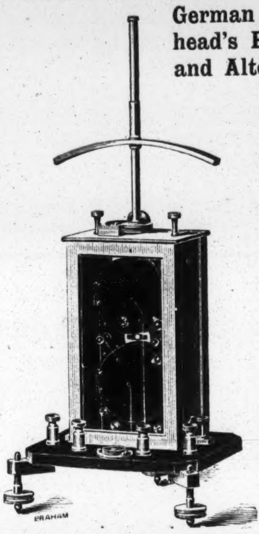

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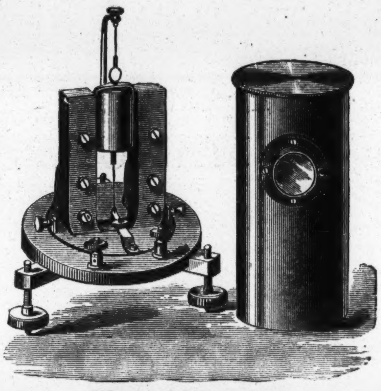

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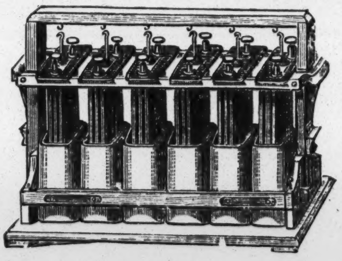

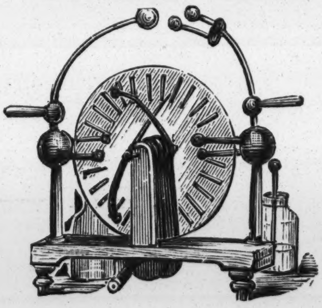

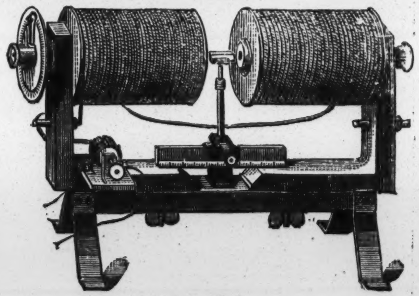

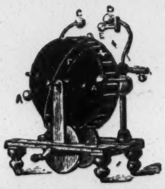

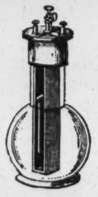

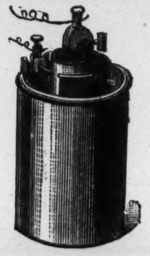

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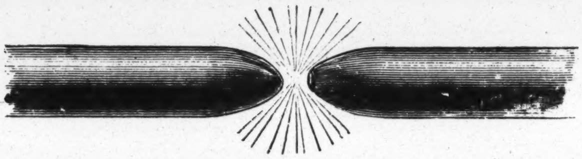

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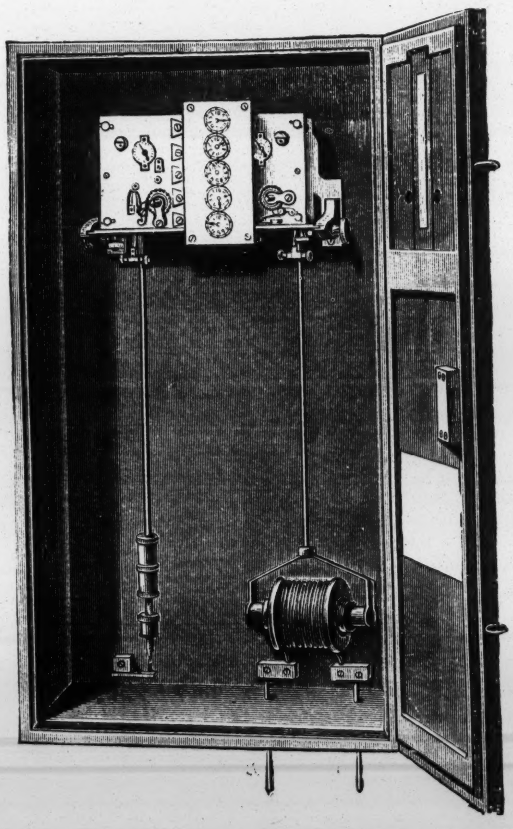

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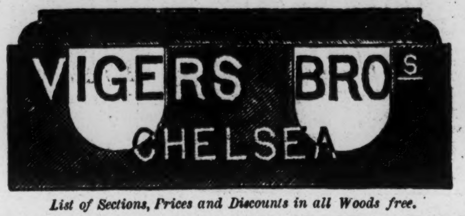

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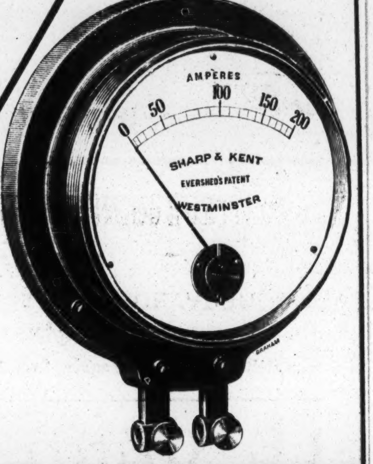

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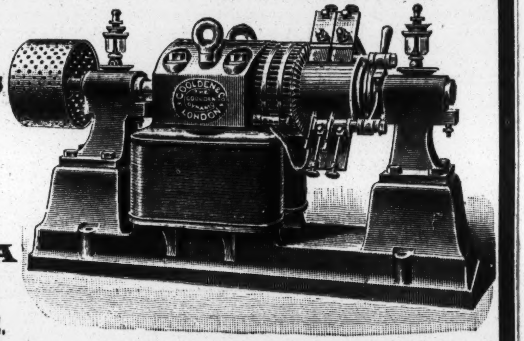

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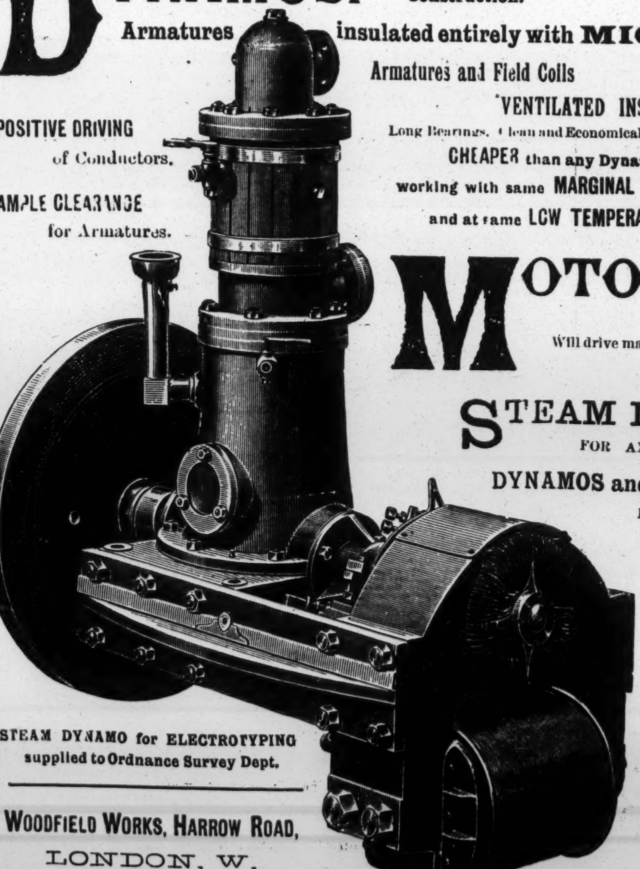

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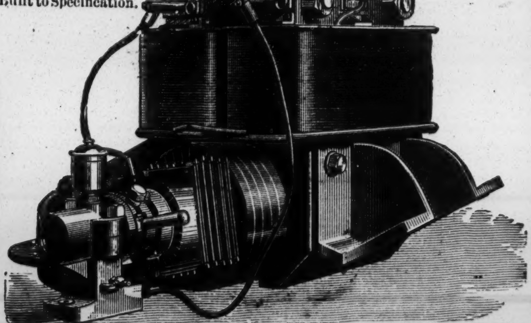

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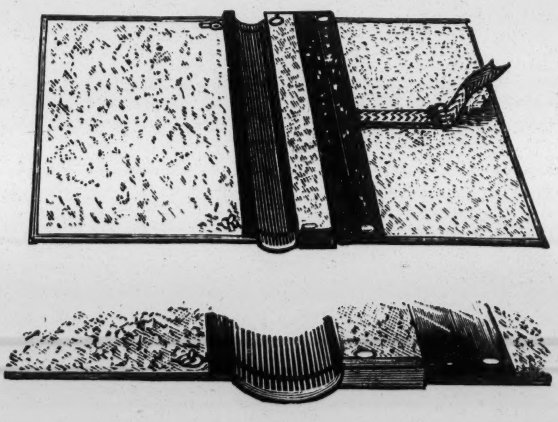

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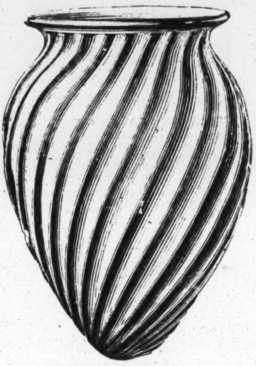

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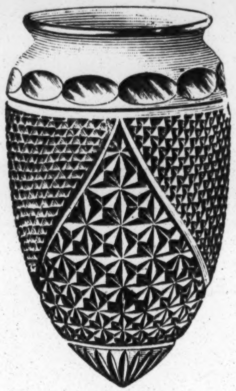

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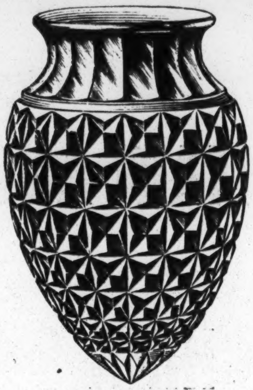

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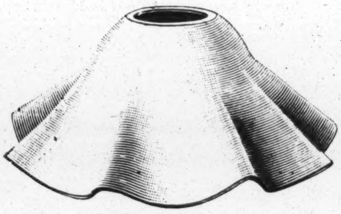

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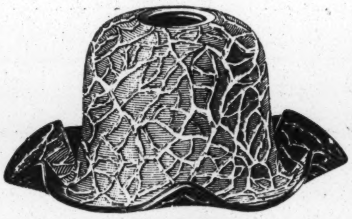

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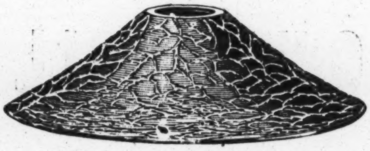

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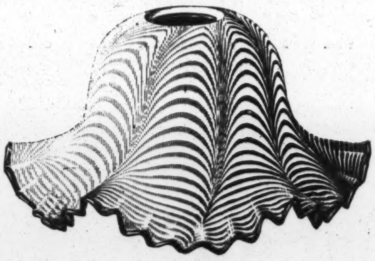

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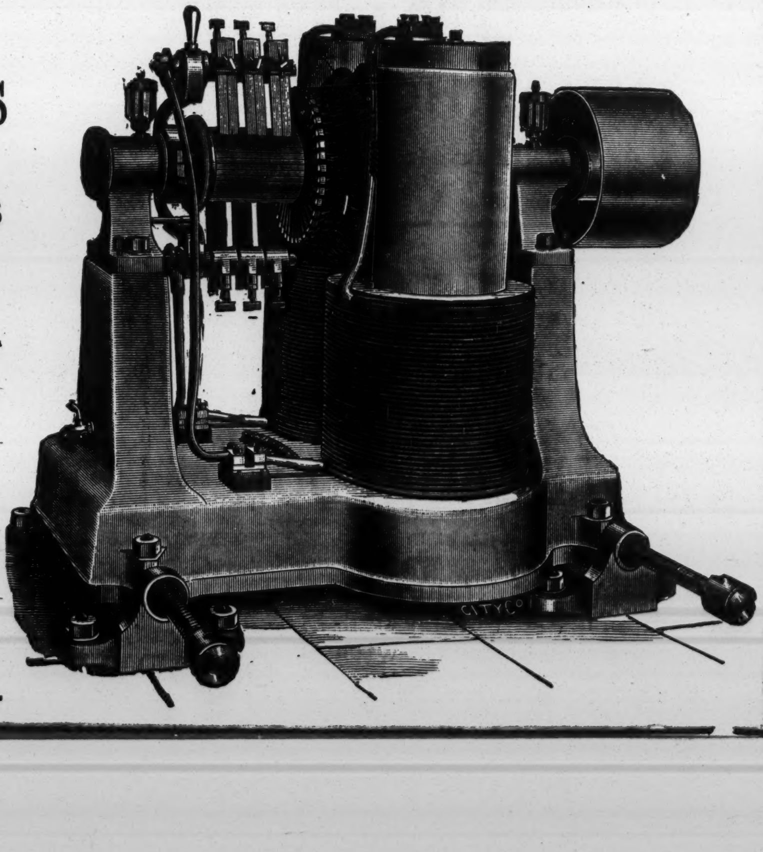

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